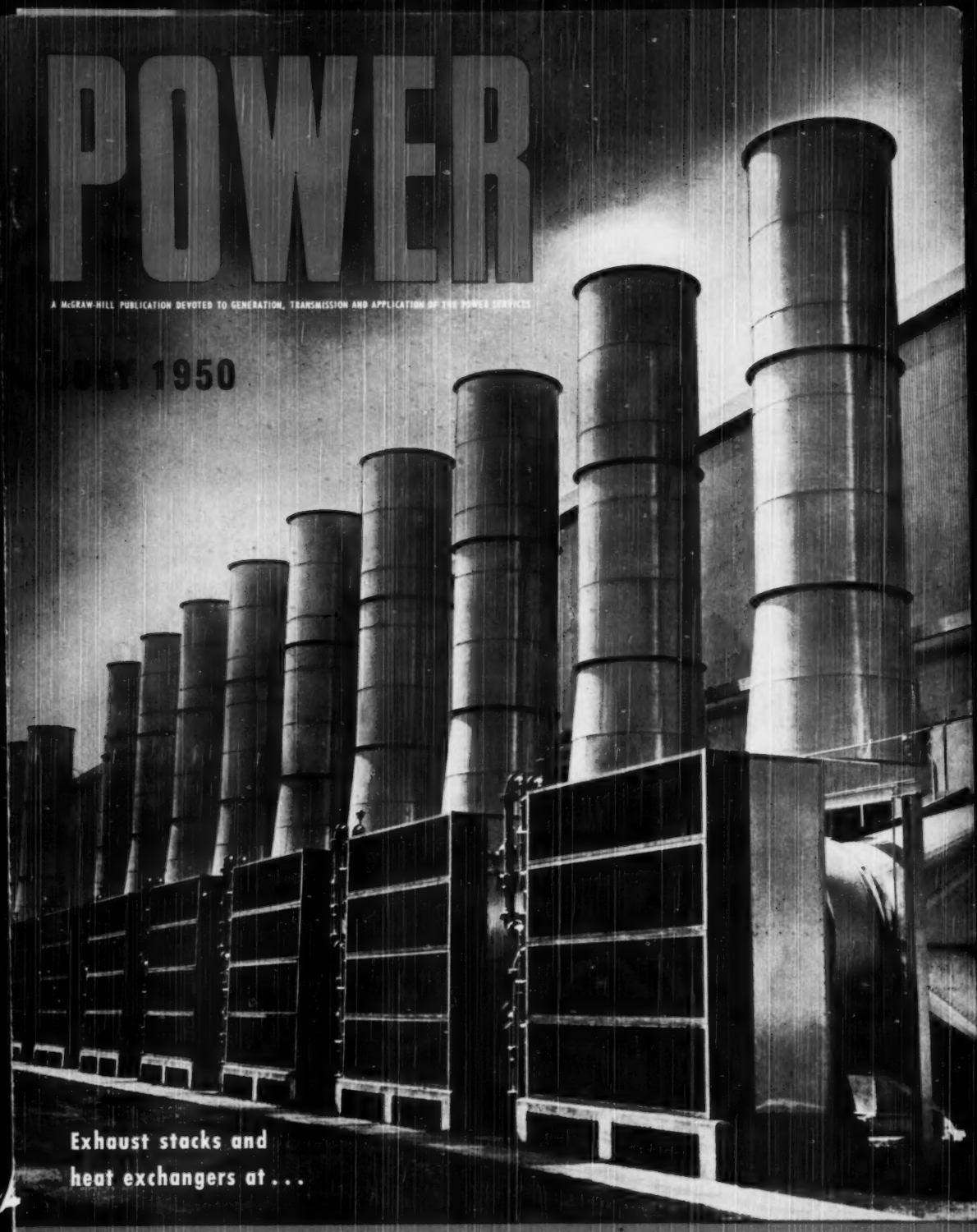
POWER

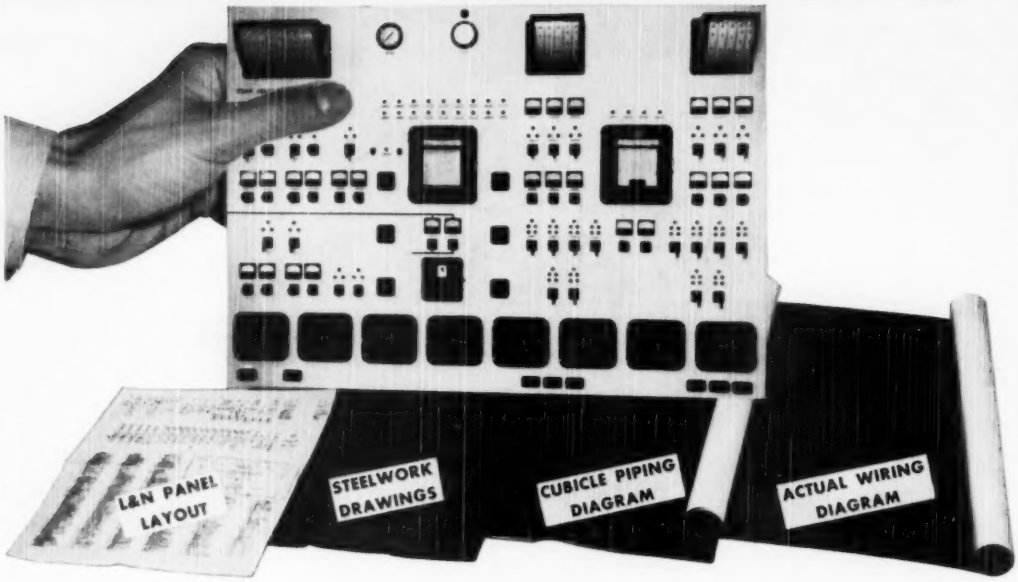
A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

AUGUST 1950



Exhaust stacks and heat exchangers at . . .

WORLD'S LARGEST GAS-ENGINE PLANT, p 76 • Contents, p 71



Save engineering and installation time With L&N-engineered panels

You can greatly reduce your own staff's engineering time and cut your installation costs by letting us engineer and build your boiler, turbine, and auxiliary control panels. Because we handle the complete project, from layout to assembly and testing, you'll find that your actual overall installed cost of control boards is reduced when we do the job for you. Here are some of the specific advantages we offer:

FUNCTIONAL PANEL DESIGN to meet the needs of **your** plant. Each cubicle is custom-built to accommodate your operating requirements. The automatic combustion, superheat, and feedwater controls, and remote stop-start control stations for the boiler and turbine auxiliaries, are grouped with their associated indicating and recording equipment. All elements are combined in a convenient operating pattern.

INTERNAL DESIGN OF CUBICLES for easy accessibility of wiring, piping and back-of-panel equipment.

DETAILED ASSEMBLY DRAWINGS. For each panel, we provide detailed steelwork drawings and complete wiring and piping diagrams.

COMPLETE FACTORY ASSEMBLY. Your panel arrives at your plant with all instruments in place, fully wired, piped and tested—ready to connect to plant equipment.

OVER THIRTEEN YEARS EXPERIENCE in designing and assembling control equipment, from individual panels to complete central control rooms. This work is a full-time responsibility of specialized engineering and production groups, who during last year designed and built about 600 front feet of control boards for large and small power plants.

An L&N field engineer will be glad to explain in detail what we can offer for your particular plant. Write to Leeds & Northrup Company, 4910 Stenton Avenue, Philadelphia 44, Pa.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl Ad N-460(5)

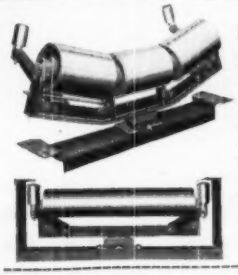
POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer" and "The Stationary Engineer"), July, 1950, Vol. 94, No. 7. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter January 26, 1949, at the post office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. Subscription rates—U. S. and U. S. Possessions $5 for one year, $7 for two years, 65c per copy. Canada $7 for one year, $11 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years. Please indicate position and company connection on all subscription orders.

Compare the LINK-BELT "100" Conveyor Idler Construction Features

Complete Line of Idlers

Troughing Idlers — illustrated above

Rubber-Tread Impact Troughing Idlers — recommended for use at loading points of the conveyor, especially when large lumps and heavy or coarse materials are being handled; to provide a cushion to absorb the impact of the material and protect the belt against bruising or tearing.



Positive Action Self-Aligning Idlers — for non-reversible belts. Should be spaced intermittently in both the carrying and return runs to automatically position the belt on the conveyor idler roadbed correcting misalignments due to off center loading, strong side winds, or unequal belt stretch. Counterweighted-Disc Self-Aligning Idlers for reversible belts are also available.

Return Idlers—have same smooth rounded-edge outer shell and interior construction as the troughing rolls, your assurance of an efficient return run with minimum belt wear.

Rubber Tread Return Idlers — for use when handling a wet or sticky material that clings to the belt, as these idlers induce a bending or kneading action to the belt which breaks the material loose. Also ideal for use when handling a material that has a corrosive action on iron or steel.

Link-Belt builds many types and designs of idlers for special services in addition to those illustrated. Refer your belt conveyor idler problem to Link-Belt for sound solutions.

For more than half a century, the name LINK-BELT has stood for pre-eminence in belt conveyor idlers and accessories. The original design has been steadily improved and now the Series "100" Idler offers top quality in this type of equipment. Installations have been made throughout the world and include some of the widest, the longest and the highest belt conveyors.

Link-Belt idlers offer such outstanding features: grease-in-dirt-out seal . . . rolls with smooth rounded-edge outer shell to minimize belt wear . . . high-grade roller bearings . . . interlocking nut and yokes to prevent brackets from spreading under unusual impact . . . end brackets of tough malleable iron are riveted to and extend well beyond the rigid T section cross member to provide stability and transmit load directly to steel bar feet which are welded to each end of the cross member . . . grease fittings for rolls are protected within the deep outer ribs of the end bracket and provide a convenient and safe means for lubrication.

Idlers can now be shipped from stock—full details on Series "100" Idlers are shown in Book No. 1915. It should be on the desk of every engineer using belt conveyors. Address the nearest office.

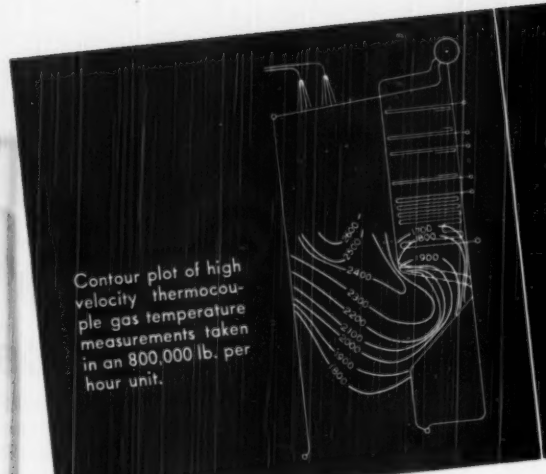
LINK-BELT COMPANY Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

11,648

LINK-BELT

CONVEYING MACHINERY

"THE COMPLETE LINE"



Contour plot of high velocity thermocouple gas temperature measurements taken in an 800,000 lb. per hour unit.

Contour plot of high velocity thermocouple gas temperature measurements taken in a unit operating at 522,000 lb. steam per hour.

Charting Furnace Fever Keeps Power Costs Down

Traditionally, boiler design is an art. As influenced by B&W research, it more and more nearly approaches a positive science. For example, where rules of thumb once determined the design of boiler surface area, now accurate empirical data is available from MHVT research, carried out with the unique B&W-developed multiple-shielded high-velocity thermocouple for precision measurement of furnace gas temperatures.

During several years' intense research, B&W's "MHVT gang" charted the furnace temperatures of nearly a hundred boilers . . . discovering troublesome hot spots . . . determining optimum heat transfer rates under widely varying conditions of service . . . providing B&W engineers with a wealth of design data that assures the highly efficient, trouble-free operation of B&W units. As a direct result of this pioneering work both boiler *size* and boiler

maintenance are kept to the minimum consistent with slagging characteristics of the fuels burned.

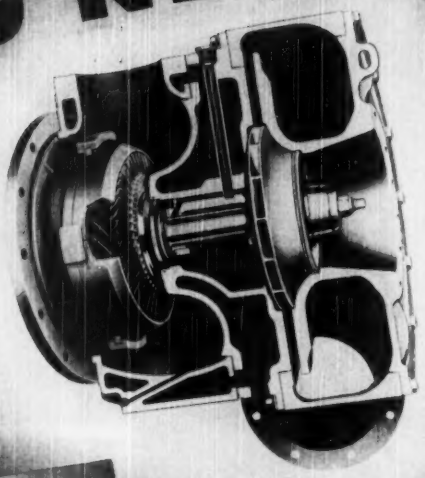
It's this sort of creative research approach to boiler engineering that has identified B&W with steam-power progress for more than 80 years . . . and may well be a source of new steam-generating economies in working out *your* present problems or future plans.

BABCOCK & WILCOX

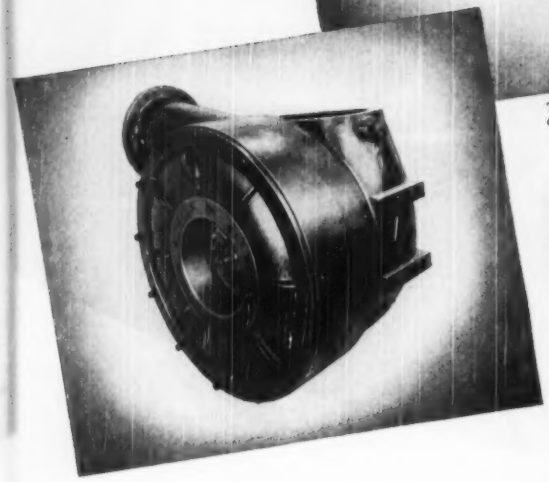
Helping industry cut steam costs since 1867

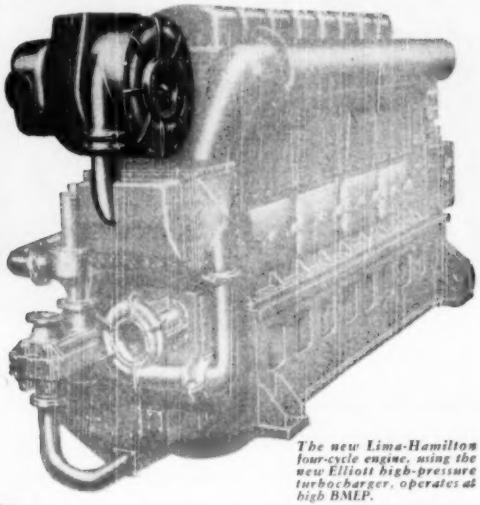
G-4911

BIG NEWS FOR



The new Elliott turbocharger is of simplified design, resulting in increased sturdiness.





The new Lima-Hamilton four-cycle engine, using the new Elliott high-pressure turbocharger, operates at high BMEP.

ELLIOTT COMPANY

SUPERCHARGER DEPT. • JEANNETTE, PA.

Plants at: Jeannette, Pa. • Ridgway, Pa. • Ampere, N. J. Springfield, O. • Newark, N. J.

DISTRICT OFFICES IN PRINCIPAL CITIES

DIESELS *the New* ELLIOTT

TURBOCHARGER

FOR FOUR-CYCLE ENGINES, 250 HP UP

IN TWO TYPES — TYPE H (HIGH PRESSURE) AND TYPE L (LOW PRESSURE)

With the experience gained in ten years of building thousands of turbochargers for four-cycle diesels, Elliott engineers have developed and proved in service two new types of turbochargers, providing even greater added power than the former design, even greater assurance of continued operation, even greater savings in fuel, in lube oil, and in maintenance.

Type H is especially designed for four-cycle diesel engines operating at high BMEP.

Type L serves low air pressure needs.

In addition to greater sturdiness and simplified design resulting in higher quality performance, the new Elliott turbochargers provide the following distinct advantages:

Driven by exhaust from the engine, with no mechanical connection, thus —

Automatically adjusted to engine load —

Rotating in one direction only, whether engine is going forward or reversing.

Every four-cycle diesel engine builder and user will be interested in this new development. Full details and data on request. Write.

M-102

STEAM TURBINES • GAS TURBINES • GENERATORS • MOTORS • CONDENSERS
FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES
TUBE CLEANERS • STRAINERS • EXPANDERS • FILTERS

AT PHILIP SPORN PLANT*:

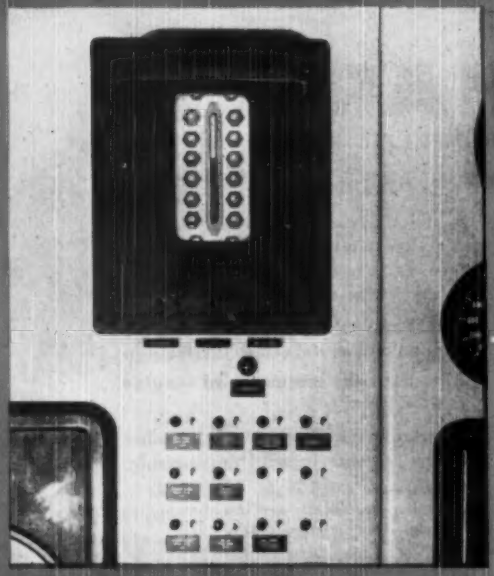
Diamond "Utiliscopes" Increase Safety and Operating Efficiency

TELEVISION IN INDUSTRY

At Philip Sporn Plant two Diamond "Utiliscopes" (wired television) enable the control room operator to see for himself the exact boiler water level . . . and the condition of the 10 burner pilots in the furnace. One "Utiliscope" camera watches boiler water level; the image of the gage shows on the viewing screen which is a part of the control panel. View-ports, which show whether burner pilots are on or off, are observed by another "Utiliscope" camera through a system of mirrors; the viewing screen on the control panel shows them as a series of 10 bright discs when all are lighted.

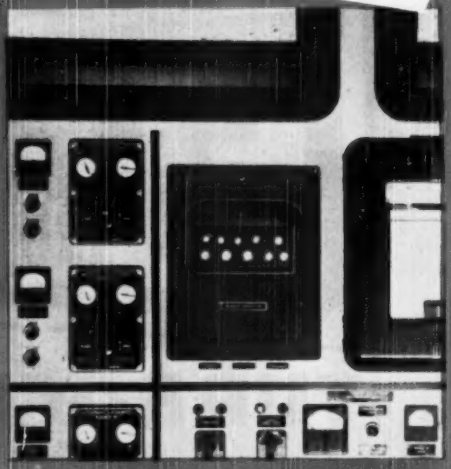
The "Utiliscope" is solving many problems in power plants and countless other places in industry. Whenever anything is too remote, too inaccessible, or too dangerous to observe directly, the "Utiliscope" is the answer. Ask for Bulletin 1025.

*Part of the American Gas and Electric Consumers System.



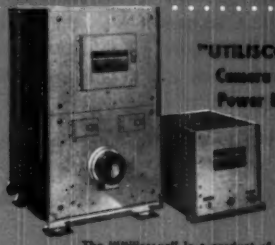
READING BOILER DRUM WATER LEVEL

The "Utiliscope" camera watches a Diamond Bi-Color Water Gauge. As indicated above, the control panel viewing screen shows a clear light and dark image which indicates water level exactly . . . changes instantly as water level changes. The "Utiliscope" provides the correct reading or no reading . . . it cannot give incorrect information.



CHECKING PILOT BURNER FLAME CONDITIONS

A "Utiliscope" camera watches the 10 burner pilot view-ports through a system of mirrors. They show on the viewing screen (which is built into control panel) as 10 bright discs. Pattern is regular, so absence of one or more discs is detected at once without counting.



"UTILISCOPE" Camera and Power Unit

The "Utiliscope" is a product of the Capehart-Farnsworth Corporation and the Diamond Power Specialty Corp. • "Utiliscope"—Registered U.S. Patent Office.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario

4271-A

AT PHILIP SPORN PLANT*:

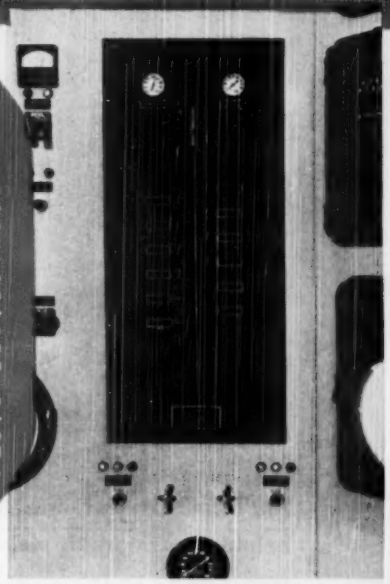
DIAMOND AUTOMATIC SEQUENTIAL SOOT BLOWING SYSTEM provides correct cleaning at minimum cost

The "human element" is eliminated from boiler cleaning by the Diamond Automatic Sequential Soot Blowing System. All blowers operate in proper sequence and at correct blowing speed every time . . . no blower can be overlooked or incorrectly operated by a careless operator. In addition to improved cleaning, there is a saving in labor as an attendant is not required by automatic operation.

At Philip Sporn Plant, Diamond Soot Blowers of various types are used according to furnace location and service required. All blowers are controlled by the control panel shown at the right. To do the complete blowing job the control room operator merely moves a lever. The control panel takes over . . . operates each blower or group of blowers correctly and in turn. On completion of the blowing cycle the panel automatically shuts off. For further information on the many advantages of Diamond Automatic Sequential Soot Blowing Systems, ask for Catalog 1014.

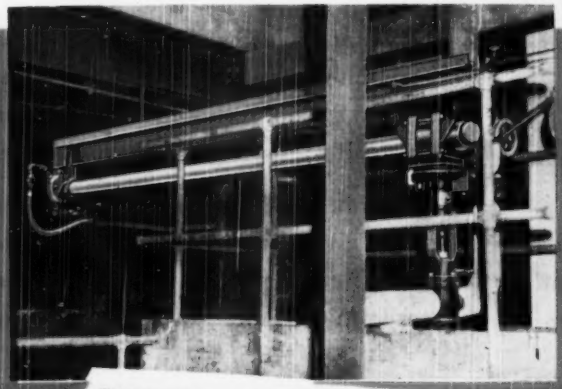
DIAMOND AUTOMATIC SEQUENTIAL AIR CONTROL PANEL

Controls automatic cleaning cycle of any arrangement of the various types of blowers. Operator starts cycle simply by moving start and stop valve carrier to the down position. Traveling upward, it operates each selected unit or group in turn and shuts off when all cleaning cycles are completed. Shows at a glance the unit in operation and those that have operated. No electrical connections of any kind.

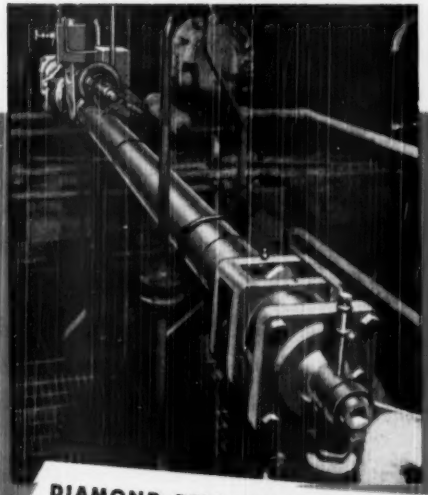


*Part of the American Gas and Electric Company System.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario

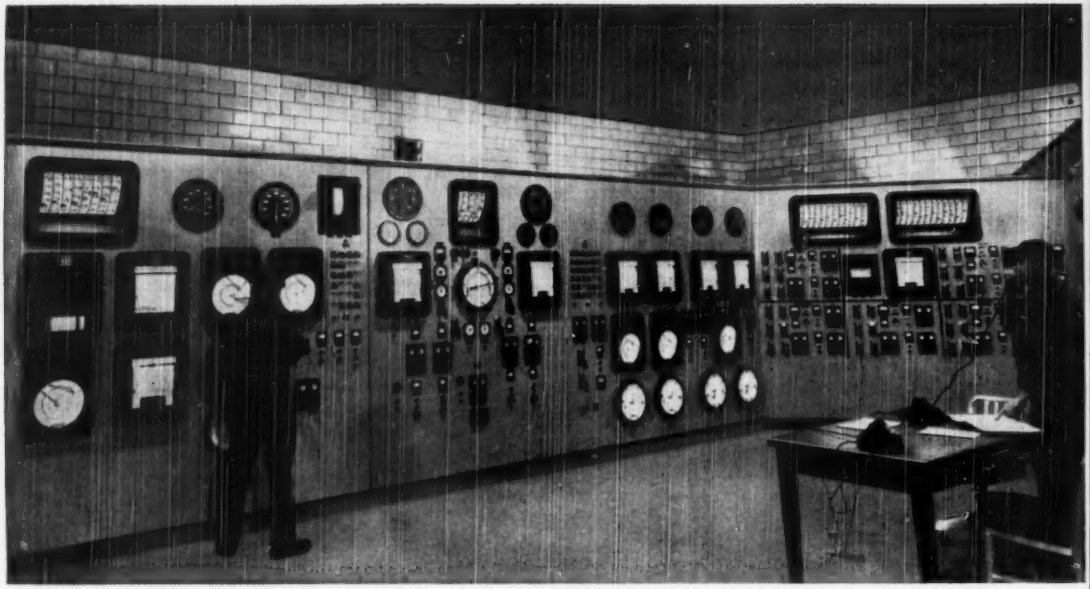


DIAMOND MODEL IK LONG RETRACTING SOOT BLOWERS



DIAMOND TELESCOPIC LONG RETRACTING SOOT BLOWERS

4271-B



In the Control

PHILIP SPORN STATION

You'll find Bailey Controls at work helping operators to maintain top performance in terms of:

Efficiency—Most power per fuel-dollar

Reliability—Highest availability of unit

Safety—Least risk to personnel and equipment

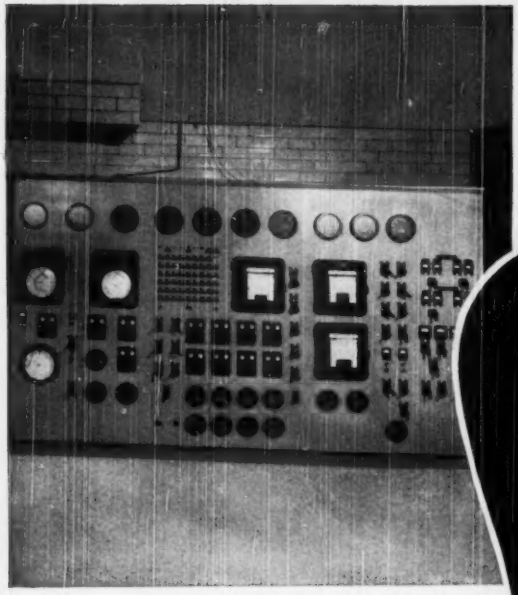
Bailey Controls can give unusually effective assistance to your operators too; because Bailey offers:

1. A complete line of fully co-ordinated metering and control equipment for all sizes and types of boiler units.
2. An experienced engineering service with a background of more knowledge and experience in steam plant operation than any other manufacturer of instruments and controls can offer.
3. Prompt and capable service with a minimum of travel time and expense. Bailey Sales-Service Engineers live in or near all major industrial communities.

Ask your local Bailey Engineer to arrange a visit to a nearby Bailey installation. We are proud to stand on our record: "More Power To You". A-110

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS



PHILIP SPORN STATION

Room at...

You'll find These BAILEY CONTROLS

Combustion	Hot Well Level
Feed Water	Heater Levels
Superheat Steam Temperature	Condensate flow
Reheat Steam Temperature	Water Treatment
Deaerator Level	Pump Recirculation

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED • MONTREAL, CANADA

120 NORDBERG provide reliable uninterrupted power in the WORLD'S LARGEST INTERNAL COMBUSTION ENGINE PLANT

★ ★ ★ ★ ★ ★ ★

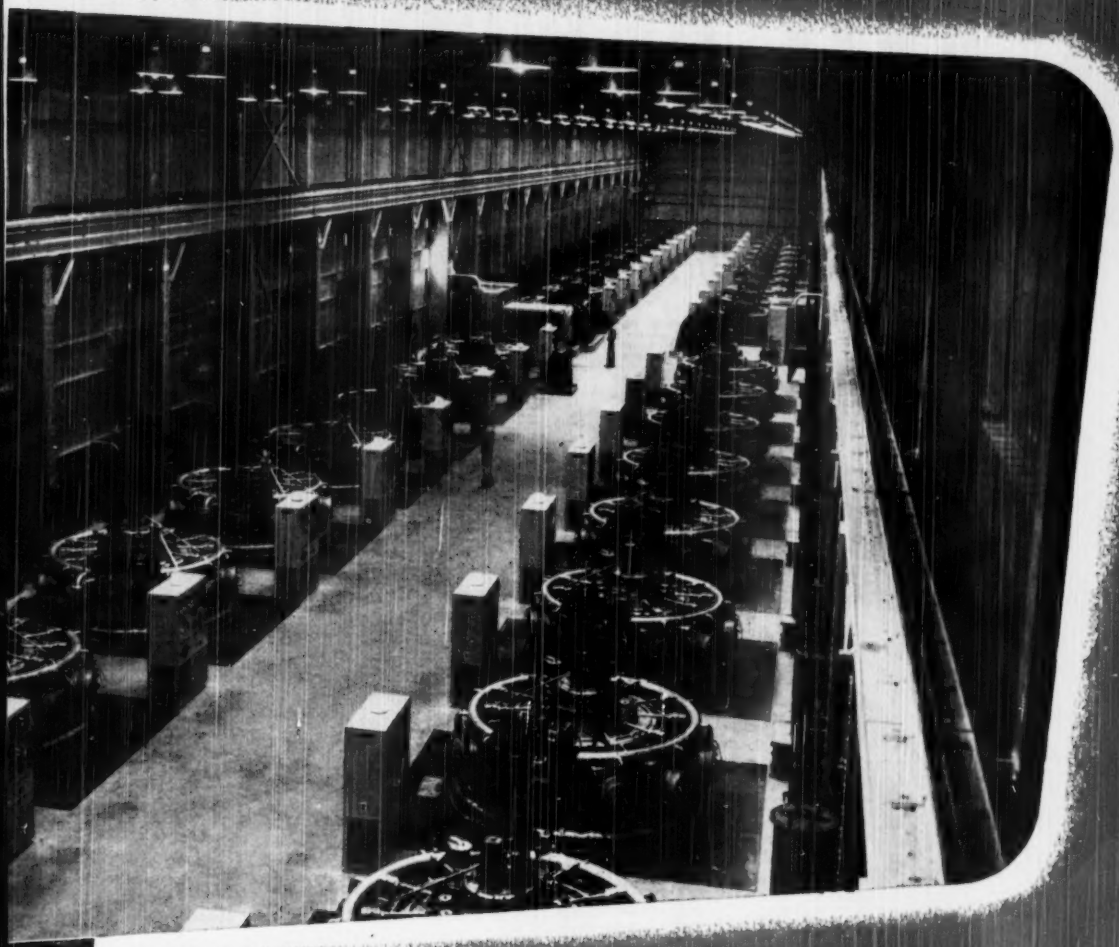
NORDBERG *Gas Burning Radials* at Alcoa's Point Comfort Reduction Works provide nearly 200,000 Horsepower *24 HOURS A DAY—365 DAYS A YEAR* to meet the full capacity demand

Important features of NORDBERG *Radial* ENGINES

- LOWER INVESTMENT COST
- LOWER INSTALLATION COST
- LOWER OPERATING COST
- LOWER MAINTENANCE COST
- LESS SPACE REQUIRED
- **AVAILABLE THREE WAYS . . . as oil burning Diesels, as natural gas engines, or as Duafuel engines.**

Applicable for industrial and municipal power plants and central stations or wherever compact, economical, dependable power is required. *For full details covering Nordberg Radials, send for BULLETIN 172.*

Radial ENGINES



IN planning the Point Comfort (Texas) Reduction Works, Aluminum Company engineers were confronted with the tremendous task of providing sufficient electric generating capacity to produce over 100,000,000 pounds of aluminum per year. By specifying 120 Nordberg two-cycle Radial Engine Generating Units as the solution to this huge power problem, Alcoa took advantage of these important economy factors:

(1) *Reduced investment cost* . . . engine-generating unit cost . . . installation cost (building size is 30% of usual requirements).

(2) Reduced operating cost . . . fuel cost . . . maintenance cost.

(3) The experience offered by Nordberg as the producer of America's largest line of heavy duty internal combustion engines.

This tremendous installation exemplifies the way in which Nordberg Diesel Engines, in sizes from 10 to 9600 hp., are used to provide dependable, economical power for stationary and marine requirements all over the world.

NORDBERG MFG. CO., Milwaukee, Wis.

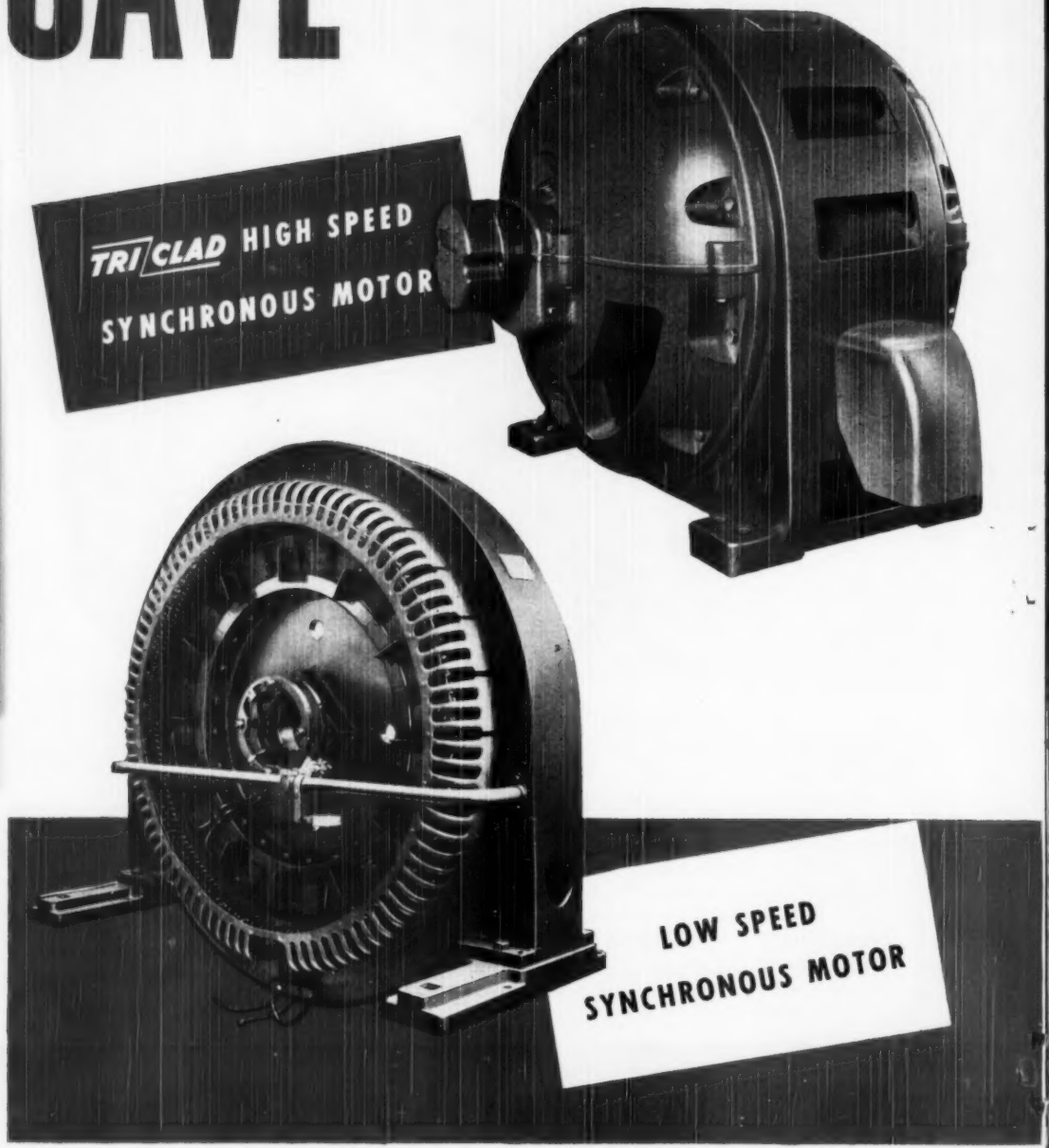
NORDBERG

DIESEL ENGINES

NORDBERG

A DIVISION OF NORDBERG

SAVE ON POWER BILLS



WITH GENERAL ELECTRIC SYNCHRONOUS MOTORS

SYNCHRONOUS MOTORS IMPROVE POWER FACTOR

1. Save you penalty charges for poor power factor

2. Save money by reducing demand and releasing needed generating capacity

Here's an example:

One mill improved power factor from 72 per cent to 84 per cent by installing a 300 hp .8 leading power factor G-E synchronous motor in place of another motor. This corrected power factor released 260 kva capacity in their generating equipment and allowed installation of additional motors.

These savings in cost of operation are available to you.

Savings in the initial cost of equipment are also available—when synchronous motors are used in their natural fields of application. To find out about these natural fields of application, get in touch with our nearest office.

REMEMBER—General Electric Synchronous motors—whenever you need constant speed. They can give you lower initial cost, lower operating cost. For bulletin information, fill in the coupon:

G-E SYNCHRONOUS MOTOR CONTROL INCREASES YOUR SAVINGS

G-E synchronous control provides the accurate adjustments that enable you to improve power factor. Here's where details count—where the slightest variation of a pointer on a meter means money saved—or lost. And General Electric has not overlooked these elements. Consider the meters for a moment. Here, G-E has devised a long scale with the pointer in the same plane as the figures so there can be no possibility of misreading the instrument. Anti-glare glass is used so no distortion is possible.

The new smaller rheostat, too, has design features that not only result in longer life but in greater operating convenience and accuracy. The handle has been molded to fit the fingers of the operator—to prevent slippage and over correction. You can be sure, too, that the new field circuit will respond instantly to rheostat adjustment.

Protection is assured the operator through the attractive steel enclosure. The cabinet resists blows, keeps out dirt and other operating hazards. All live parts are strongly guarded. Plant appearance is improved with this control designed to line up with other G-E power units such as switchgear. Ask your nearest G-E office for more information about this equipment that safeguards your investment . . . helps save operating expenses.

GENERAL ELECTRIC

Apparatus Dept., Sec. G770-6
General Electric Co., Schenectady, N. Y.

Gentlemen:

Please send me: ☐ GEA-5332, Low-speed Synchronous Motors; ☐ GEA-5426, High-speed Synchronous Motors; ☐ GEC-505, Synchronous Motor Control.

Bulletins needed for:

☐ Reference purposes ☐ Planning immediate project

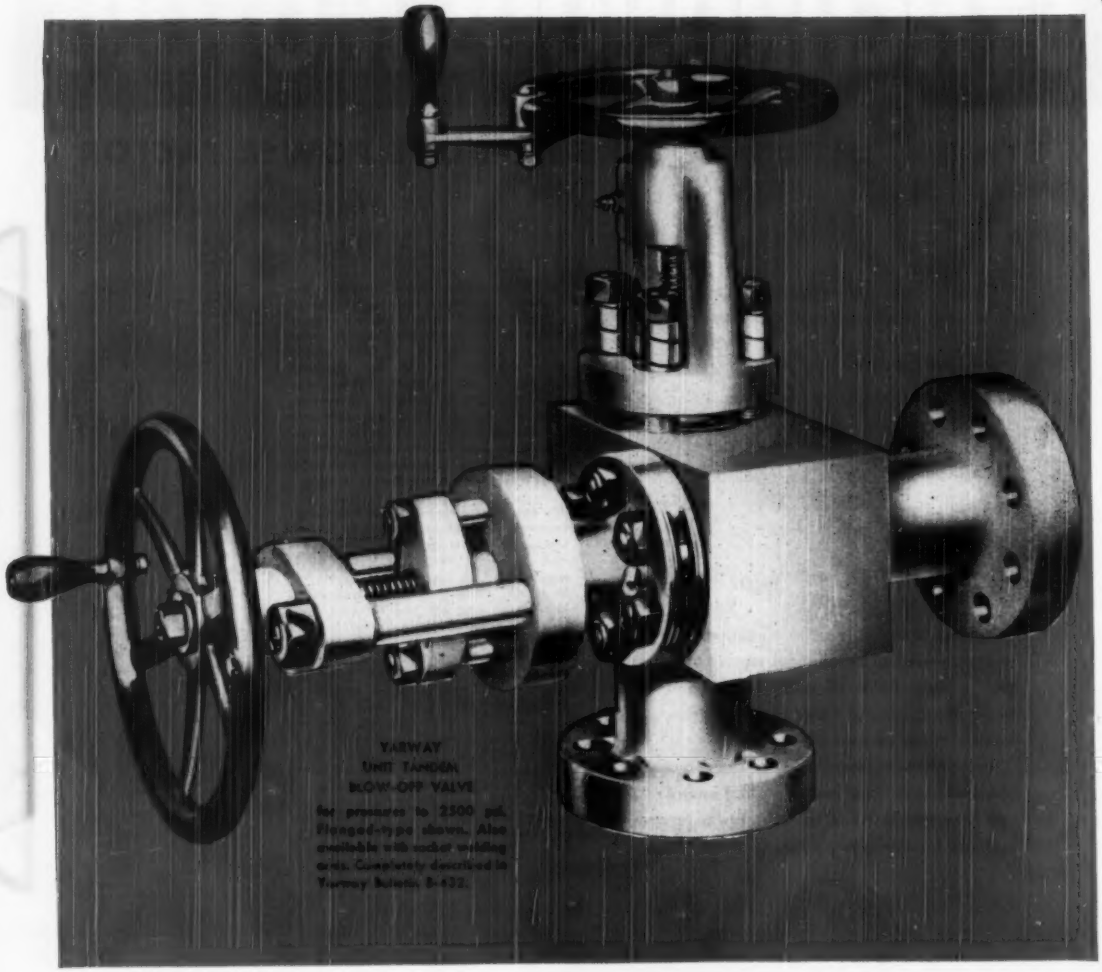
Name .....

Position .....

Address .....

City ..... Zone ..... State .....

YOUR BOILER



YARWAY

IS WORTH A *GOOD* BLOW-OFF VALVE

Boilers represent sizable investments . . . certainly worth protecting with the most dependable boiler trim you can get.

You need good blow-off valves—valves that keep blow-down lines tight, don't wear, clog or leak, and are rugged enough to stand up under the severe shock of regular or emergency blowing-down under pressure.

Yarway Blow-Off Valves meet those requirements. Both Yarway Seatless Valves with balanced sliding plunger, and Yarway Stellite-faced Hard-Seat Valves embody the most recent developments in design and metallurgy.

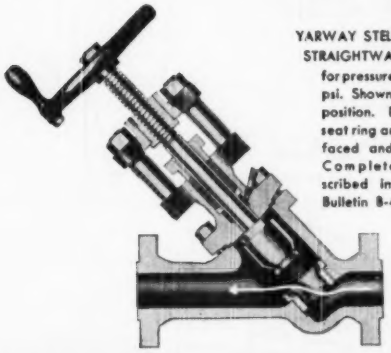
Engineers tell us the sturdiest of all blow-off valves is the Yarway Unit Tandem. This famous valve combines either a seatless and hard-seat, or two hard-seat valves, in a one-piece forged steel body. It is made for pressures up to 2500 psi. Other Yarway Blow-Off Valves meet lower pressure requirements.

It is significant that more than 15,000 plants throughout the world use Yarway Blow-Off Valves . . . and among the higher pressure plants, 4 out of every 5 are Yarway-equipped!

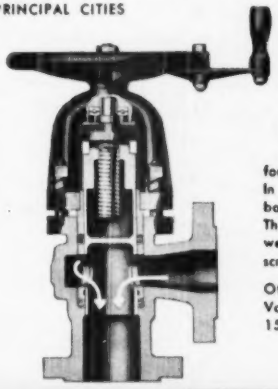
A Yarway bulletin will tell you in detail how these valves can protect *your* boiler investment. Write today, stating pressure range.

YARNALL-WARING COMPANY, 100 Mermaid Avenue, Philadelphia 18, Pa.

BRANCH OFFICES IN PRINCIPAL CITIES

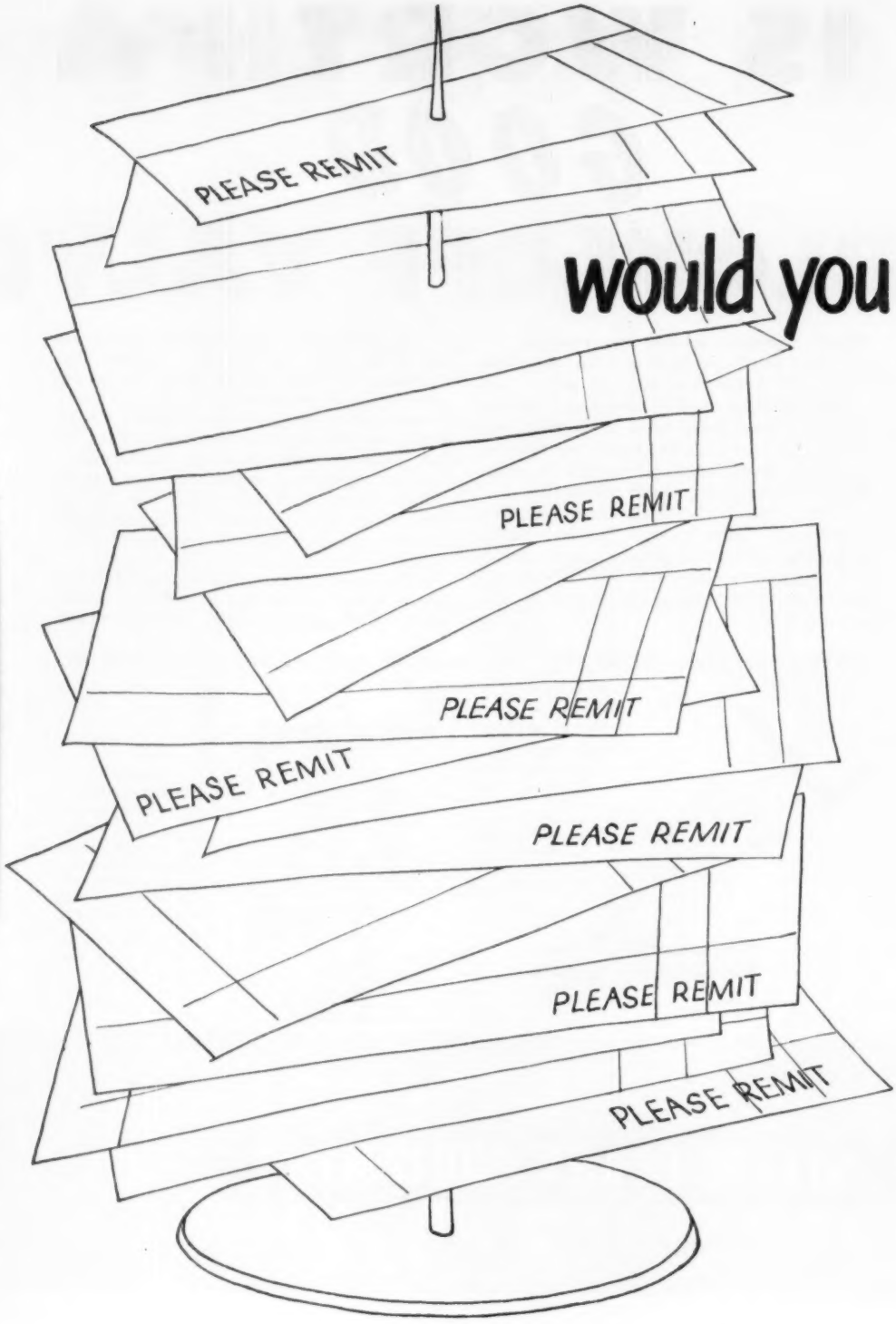


YARWAY STELLITE-SEAT STRAIGHTWAY VALVE for pressures to 2500 psi. Shown in open position. Disc and seat ring are stellite-faced and ground. Completely described in Yarway Bulletin B-432.



YARWAY TYPE "B" SEATLESS ANGLE VALVE for pressures to 400 psi. In open position. Notice balanced sliding plunger. There is no seat to score, wear, clog or leak. Described in Bulletin B-424.

Other Yarway Seatless Valves for pressures to 1500 psi.


PLEASE REMIT
would you
PLEASE REMIT
PLEASE REMIT
PLEASE REMIT
PLEASE REMIT
PLEASE REMIT
PLEASE REMIT

pay 16 times

FOR THE SAME CONTROL SYSTEM?

Of course you wouldn't — but maybe you *do*.

Let's consider a few figures. At a conservative estimate, a good boiler will give you 200,000 hours of service. If it is a 100,000 lb/hr boiler it will burn during that time not less than $8,000,000 worth of fuel—even at today's prices.

If, through failure of your control system to give maximum combustion efficiency, you waste as little as *one per cent* of that fuel, your control system will have cost you $80,000—in addition to what you paid for it originally.

You will still have the same control equipment (you started with)—but you will have paid for it *sixteen times* over!

With a system by Hagan, you pay for your control just *once*. Hagan Automatic Combustion Control Systems are designed for *precise* control. When they are placed in service, they are adjusted by Hagan's experienced combustion engineers, who make sure that you *get* the precision which is built into the control system.

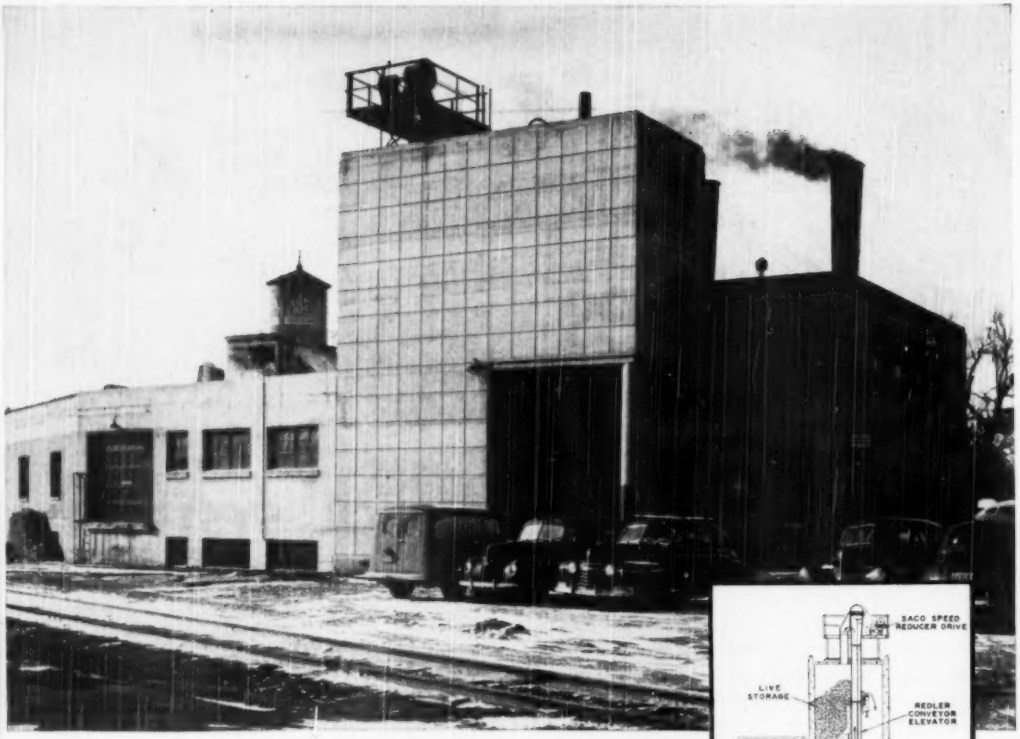
Then, by way of extra dividends, Hagan gives you *long life* and *low maintenance*. The ruggedly built components of the Hagan system last as long as the boiler—and longer. Simplicity of design, using the fewest possible parts, and affording minimum opportunity for wear, makes maintenance especially easy and inexpensive.

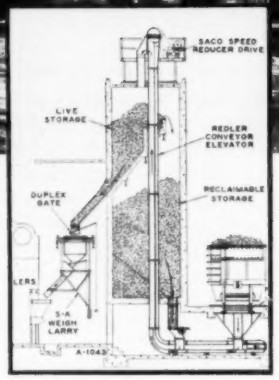
Hagan controls are used on every size of boiler from 5,000 pounds per hour at 3 psi to 1,340,000 pounds per hour at 1800 psi. They have been applied to boilers burning oil, coal, gases of various types, sawdust—and always with satisfactory results.

Our engineers will be glad to give you full information on Hagan control systems. Write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES





Coal Always Ready On the Shelf

...AND GOOD ARCHITECTURE, TOO!

At this modern food processing plant, one objective was to completely enclose coal handling in a compact, rectangular silo instead of in the more conventional round structure. S-A engineers achieved completely mechanized coal handling at low cost. A REDLER Conveyor-Elevator moves 20 tons an hour . . . "puts it on the shelf" ready for immediate use . . . or in nearby storage for quick reclaim (see drawing). Here's a modest size power plant where efficient operation and good architecture harmonize.

This unusual installation typifies the versatility and resourcefulness of S-A engineers in finding the best answers to specific problems of coal and ash handling. In talking over your needs with an S-A engineer, you are always assured that he is not biased in favor of a particular type of equipment. Stephens-Adamson makes *all* types . . . and, consequently, S-A engineers are free to recommend the unit or units best suited to your actual requirements. If you plan a new or remodelled conveying system, write us today . . . there is no obligation.

PETER ECKRICH & SONS
KALAMAZOO, MICHIGAN

Coal, delivered by rail cars to a track hopper, is fed to the lower horizontal run of a REDLER Conveyor-Elevator. Same conveyor curves into vertical run of casing and elevates coal 50 feet to live storage shelf inside and near top of silo. Coal then chutes from bottom of storage shelf into boiler room through duplex gate to a movable S-A Weigh Larry. The latter moves to discharge measured load to any one of several boiler stokers. When storage shelf is full, coal spills over and falls to bottom of silo. From there it is easily reclaimed through a chute which returns it to the REDLER Conveyor-Elevator.

STEPHEN S-A DAMSON MFG. CO.

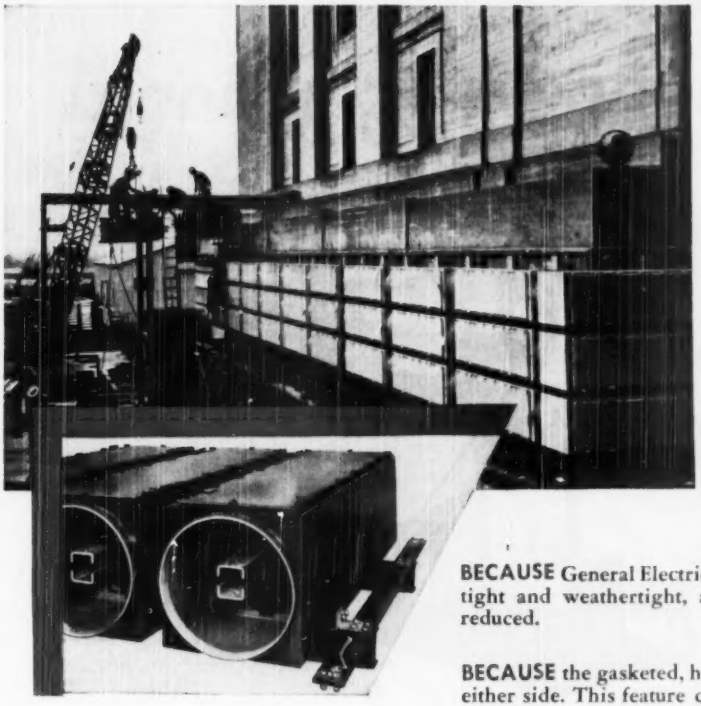
5 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif. • Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

11 of the 16 largest turbine-generators*

use

GENERAL ELECTRIC ISOLATED PHASE BUS RUNS



RATINGS
15 and 23 kv
1200 to 7000 amperes

Your G-E Sales Representative has complete information about isolated-phase bus runs. Ask him for a copy of GEA-5460, a 28-page publication that will aid you in planning your bus runs, or write to *Apparatus Department, General Electric Company, Schenectady 5, New York.*

BECAUSE General Electric isolated-phase bus runs are dust-tight and weathertight, and maintenance costs are thus reduced.

BECAUSE the gasketed, hinged covers can be opened from either side. This feature cuts inspection time and costs by allowing access to the interior of the run from the most convenient position. Cover lugs release the cover without removal of bolts. The cover is swung open on either one of two sets of hinges.

BECAUSE you receive G-E isolated-phase bus runs completely assembled as a three-phase package, including running ground bus. They are installed in a short time at lower predictable costs.

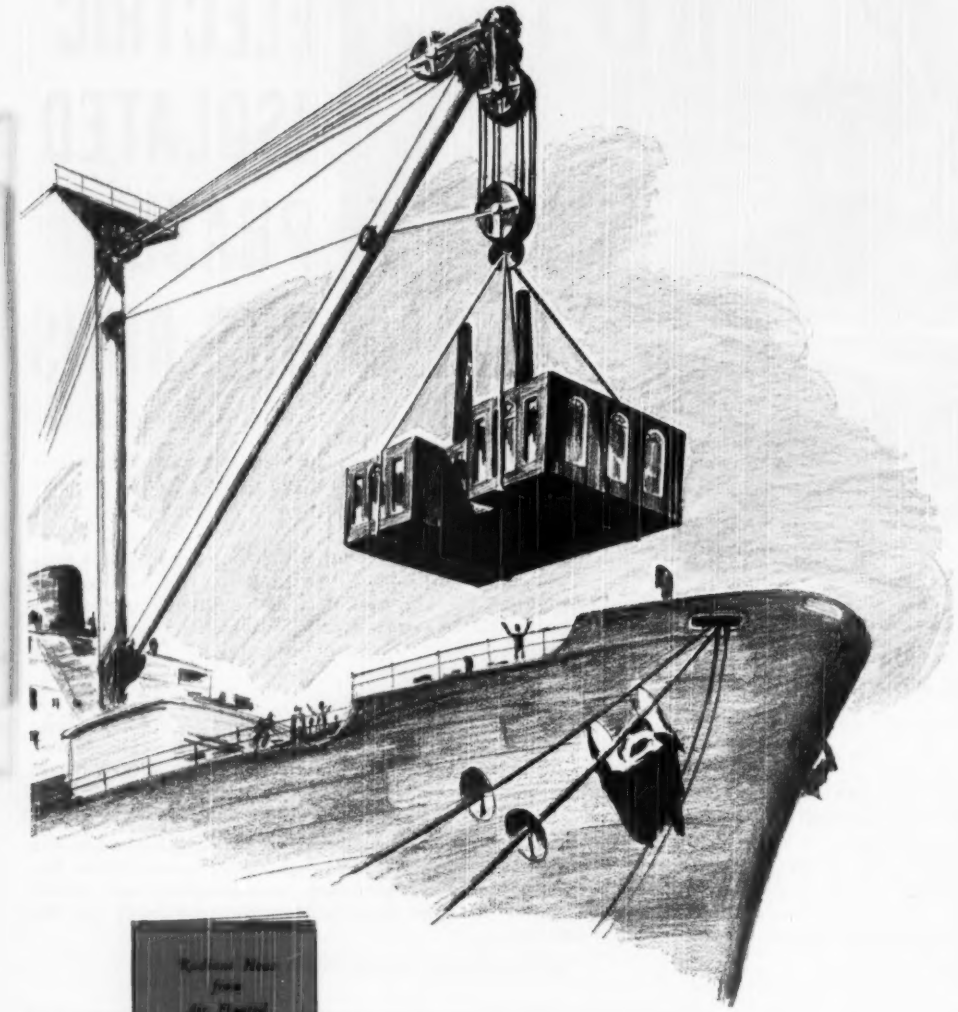
BECAUSE you have one source of responsibility when you order from General Electric—complete co-ordination between planning, engineering, manufacturing, and service facilities to give maximum savings efficiency to the customer.

*Installed and planned, rated 6000 amperes and over.

GENERAL ELECTRIC

455-24

THIS KVS ENGINEERED



Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.

POWER PLANT

is going on a long journey

You name the

SIZE...
PLACE...
FUEL...

YOU specify the requirements . . . KVS will build the plant. If you need assistance in determining exactly what is most advisable as a means of achieving low cost power, or if you want help in writing specifications, KVS will cooperate with you on these problems also.

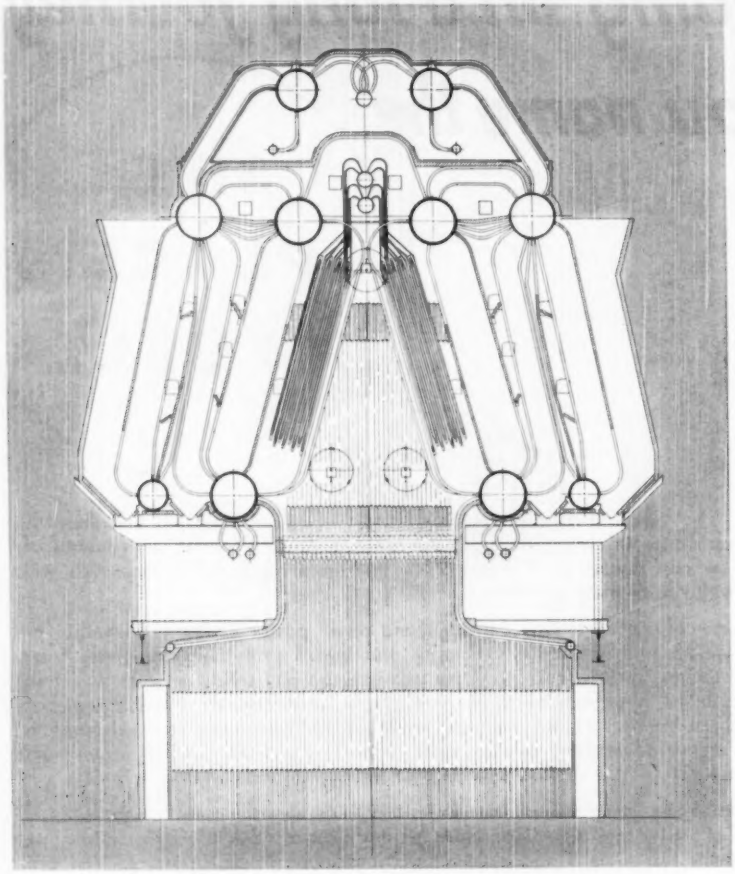
Complete service by KVS means the furnishing of all power equipment whether or not built by KVS. It is available to supply and install everything complete, from bunker to bus bar, guaranteed as to performance on any solid fuel that will burn and for which the plant has been designed. From the standpoint of fuel, this means low cost power from screenings, tailings, washings, etc. It means coal preparation equipment, steam generators, turbines and generators and all auxiliary equipment and components.

This comprehensive, complete service is available for steam power plants erected *in any part of the World*. Our experience on this class of work is your assurance of our competency to handle it and meet all guarantees as to performance. You are invited to investigate.

Kennedy Products — New York USA

Kennedy-Van Saun
MANUFACTURING AND ENGINEERING CORPORATION
2 PARK AVENUE • NEW YORK 16, N. Y.
FACTORIES: DANVILLE, PA.
CANADA • ENGLAND • FRANCE • AUSTRALIA

"... a remarkable job of



Nominal rating: 850,000 pounds per hour at 400 psi and 750° F. Each Ladd-type C-E boiler has six fully-automatic Vulcan long retractables installed in very congested space where temperatures are severe. The boilers are kept clean at all times. No hand lancing is needed.

VULCAN Automatic

keeping the boilers clean"

Here's what the Production Department reported . . . .

"The first year of operation of the Vulcan retractable soot blowers at . . . . . Station has been a decided success. A total of eighteen blowers (six per boiler) have been in daily service without the loss of a single lance . . .

". . . the soot blowers have done a remarkable job of keeping the boilers clean. Each . . . has been kept clean and in condition to exceed a million pounds of steam per hour rating at any time."

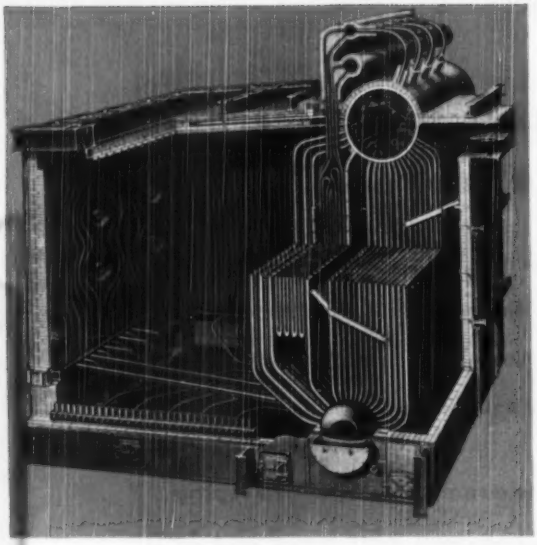
—— V ——

These three boilers had been in service almost twenty years. The original soot blowers—even when supplemented by daily hand lancing—had been unable to clean adequately the boiler and superheater tubes.

Narrow aisles and interferences from building steel and other equipment created a difficult installation problem, but Vulcan solved it. Just as Vulcan can solve your trickiest problem of keeping boilers clean.

VULCAN SOOT BLOWER DIVISION
Continental Foundry & Machine Company
DUBOIS, PENNSYLVANIA

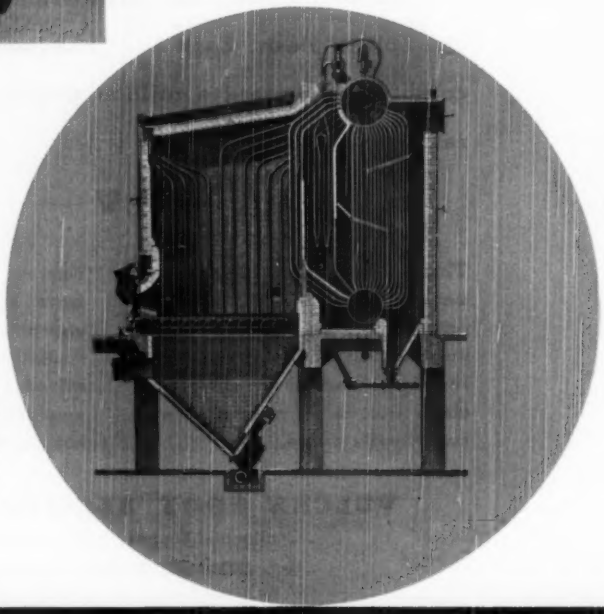
WHICH fits



Type VU-50

(for the higher capacity range)

This unit, the original VU design, may be fired by pulverized coal, oil or gas, or any combination of these fuels. Available for capacities up to 300,000, or more, lb of steam per hr, pressures up to 1000 psi and steam temperatures up to 900 F, or higher. Furnace bottom may be as shown or may be of hopper type. Economizer or air heater surface may be added.



Type VU-30

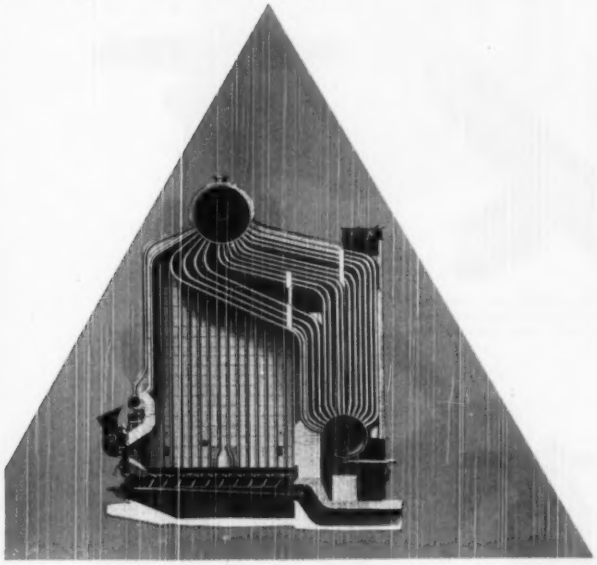
(for the middle capacity range)

In this VU design, shown equipped with a C-E Spreader Stoker, the furnace proportions and arrangement of water wall surfaces may be adapted for firing by any type of mechanical stoker. Design is also adaptable for firing by oil or gas. Economizer or air heater surface may be added. Approximate capacity range 25,000 to 100,000, or more, lb per hr.

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

Vertical-Unit Boiler <u>your</u> special needs ?



Type VU-10

(for the lower capacity range)

This member of the VU family is designed for industrial load conditions and particularly for plants having small operating and maintenance forces. Capacities range from about 10,000 to 60,000 lb per hr. Firing may be by spreader, underfeed or chain grate stokers, or by oil or gas burners. Superheater, economizer or air heater surface may be added if desired.

No matter what your combination of operating conditions, one of these three units can meet the particular requirements of your plant *exactly*.

CAPACITY: Vertical-Unit Boilers are available for capacities ranging all the way from 10,000 lb of steam per hr up to 300,000 or more lb per hr.

PRESSURES—TEMPERATURES: VU Units are available for steam pressures up to 1000 psi and temperatures up to 900 F, or more.

FUEL REQUIREMENTS: The larger designs may be fired by pulverized coal, oil or gas, or any combination of these fuels. In the medium and lower capacity ranges firing may be by any type of mechanical stoker or oil or gas. Moreover, it is possible to substitute any one of these methods for another should a change in the fuel market occur.

This flexibility . . . this ability to meet the widely varying requirements of plants in virtually every branch of industry — at efficiencies ranging up to 88% — accounts for the wide acceptance of the Vertical-Unit Boiler. Throughout the United States and Canada, Latin America and abroad, the VU has been selected for installations with an aggregate capacity of well over 100,000,000 lb of steam per hour.

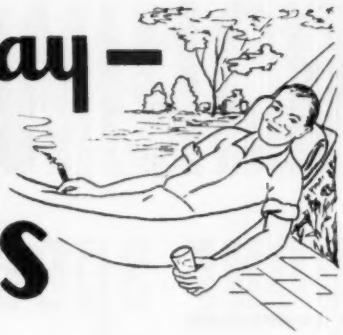
Whether you are considering the purchase of equipment for replacement or expansion, or for a new plant, a C-E Vertical-Unit Boiler will provide the right answer to your particular situation. We shall be pleased to supply catalogs and any additional information upon request. 392-A

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

Do it the EASY way — *Standardize on* POWELL VALVES



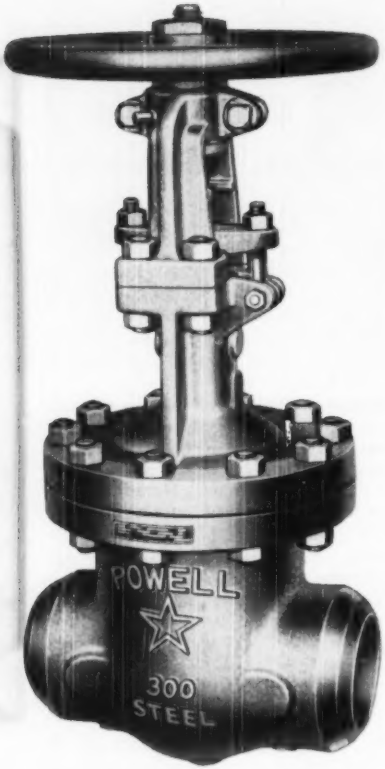


Fig. 3003 W. E.—Class 300-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

Fig. 1365-A—Class 1500-pound, small size, Steel "Y" Check Valve. Pressure Seal construction. This type of valve also available in angle pattern.

Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve. Sizes 2" to 30", incl. Has flanged ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge.

Fig. 1331-A—Class 1500-pound Steel Integral Bonnet Offset Globe Valve with welding ends. Also available in Angle and "Y" patterns.

POWELL

When you get your valves from various sources, buying for replacement—and stocking spare valves and parts—becomes unnecessarily complicated.

But when you buy ALL your valves—Bronze, Iron, or Steel, and, if you need them, Corrosion-Resisting Valves—from ONE source, you have the answer to your flow control problems. Powell makes them all* and makes them better. Also Powell makes the *only* COMPLETE Line of Valves for Corrosion-Resistance available to Industry today.

Fig. 2433—150-pound Bronze Regrinding Swing Check Valve with flanged ends and bolted flanged cap.

Fig. 11313 W. E.—Class 1500-pound Cast Steel Pressure Seal Gate Valve with welding ends, venturied ports and special by-pass. Bevel gear operation. Also available with top-mounted electric motor operator.

Fig. 11331 W. E.—Class 1500-pound small size Cast Steel Pressure Seal Globe Valve with welding ends. This design permits practically unobstructed flow through the valve body, thus reducing pressure drop and turbulence to the minimum.

***The Complete Powell Line includes Globe, Angle, "Y", Gate, Check, Non-return, Relief, and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-resistant metals and alloys.**

Ask your nearest Distributor—or write direct

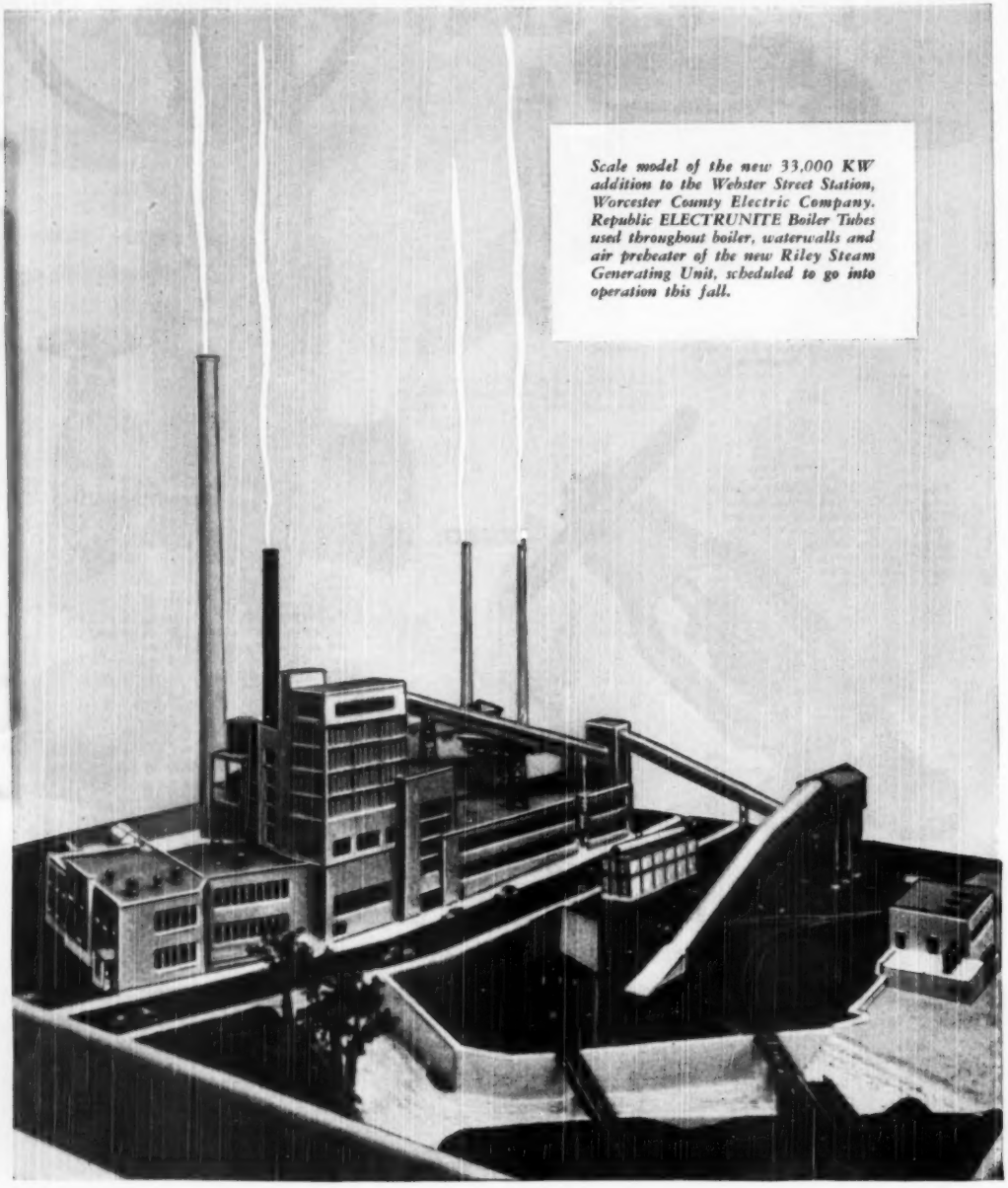
The Wm. Powell Company, Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

VALVES

AT WORCESTER COUNTY ELECTRIC COMPANY...

it's ELECTRUNITE



Scale model of the new 33,000 KW addition to the Webster Street Station, Worcester County Electric Company. Republic ELECTRUNITE Boiler Tubes used throughout boiler, waterwalls and air preheater of the new Riley Steam Generating Unit, scheduled to go into operation this fall.

BOILER TUBES

in NEW Webster Street Station Steam Generating Unit Installation

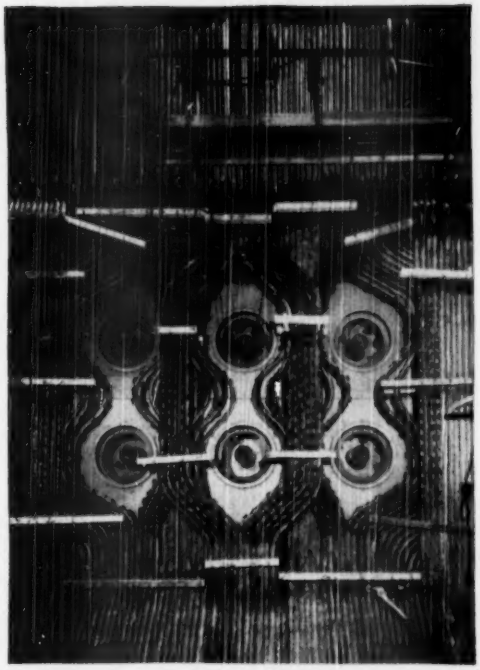
More power to Worcester, Mass. Another leading central station installation of ELECTRUNITE Boiler Tubes.

That, in brief, sums up the new addition to the Webster Street Station, Worcester County Electric Company. When completed this fall, this unit will add another 33,000 KW to meet the heavily increased demands of Worcester's industrial and residential electricity users.

Here, as in countless other installations, there were definite and tangible reasons why the boiler manufacturer specified Republic ELECTRUNITE Boiler Tubes.

Among those reasons: consistent uniformity in wall thickness, diameter and concentricity . . . unvarying high ductility throughout every length . . . smooth surface finish, free from defects *inside and out.*

Let these same reasons be your guide the next time you specify tubes for new or existing boiler units. In the meantime, we'll be glad to send you complete information about ELECTRUNITE Boiler Tubes and the process by which they are made. Write *today* to:



Interior of Riley Steam Generating Unit showing arrangement of tubes on furnace wall. This unit designed to provide 325,000 lbs. of steam per hour, operating at 925 lbs. pressure and 900°F.

REPUBLIC STEEL CORPORATION
STEEL & TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York

Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

"operation" SUB-ZERO

The Foster Wheeler Outdoor Steam Generator illustrated here is designed to operate under severe climatic conditions at an elevation of 3100 feet. The plant is being engineered and constructed by Ebasco Services Incorporated for the Montana Power Company at Billings, Montana and will supplement the company's present hydro system, providing additional capacity to take care of load growth.

An enclosed firing aisle is provided and the space under the firing aisle and furnace floor is housed to afford storage and shop space. The drum ends are enclosed so as to house the water columns, gage glasses, safety valves, etc. Small piping for such items as instruments, controls, drains, is enclosed within ducts terminating in the drum end enclosures, with the ducts being heated during freezing weather.

Plant site on the banks of the Yellowstone River

FOSTER WHEELER CORPORATION

FOSTER WHEELER
Outdoor Unit for the
MONTANA POWER COMPANY
at Billings, Montana

Model of plant

Capacity . . . . . 675,000 lb per hr

Superheat Control Range . . . . 425,000 to 675,000 lb per hr

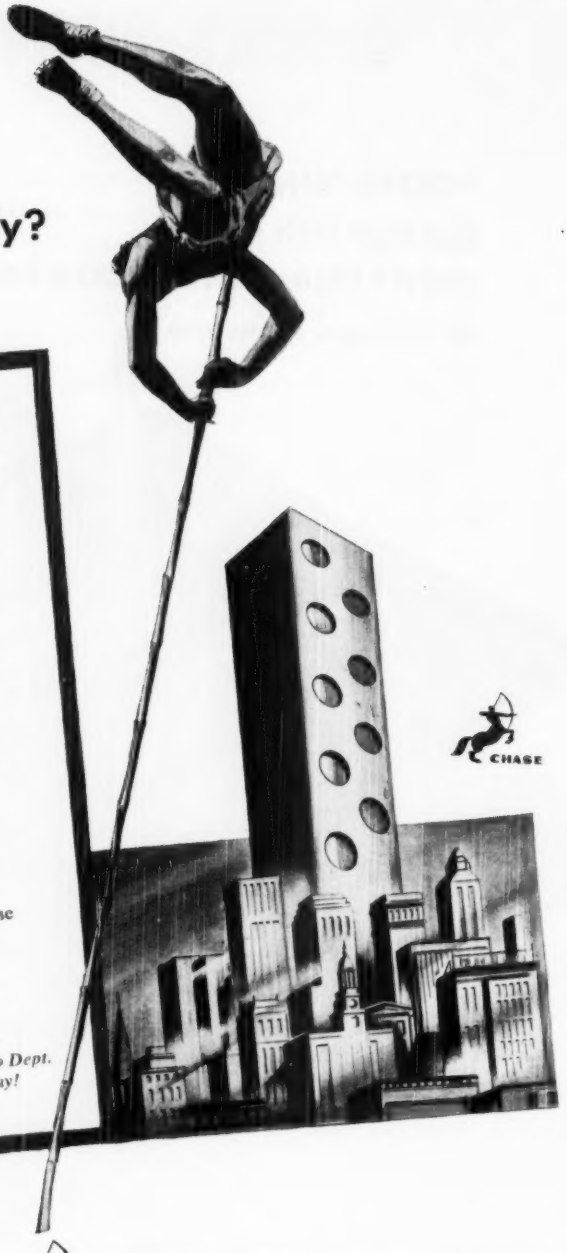
Pressure Superheater Outlet . . 920 psi

Final Steam Temperature . . . . 905 F

165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

Want to carry power vertically?



CHASE SQUARE COPPER TUBE BUS CONDUCTOR

is the way to handle it

THE SQUARE SHAPE of Chase Copper Tube Bus Conductors means more rigid construction . . . higher mechanical strength to resist the stresses of short circuits. With four flat sides, and a large cross-sectional area, they can be securely anchored to the floor, assembly is easier . . . efficient and economical connections can be made to power-and-light panels. And — there is no danger of insulation moving downward, to leave thinly protected sections.

IN ADDITION to having excellent current-carrying capacities and extreme resistance to corrosion, Chase Square Copper Bus Conductors require only one tube per phase . . . minimize "skin effect" . . . can be arranged in triangle-formation, resulting in equal spacing and equal voltage between phase conductors.

• *For complete information about these stronger, better Bus Conductors, write to Dept. PO750, Chase Brass & Copper Co., today!*

Chase

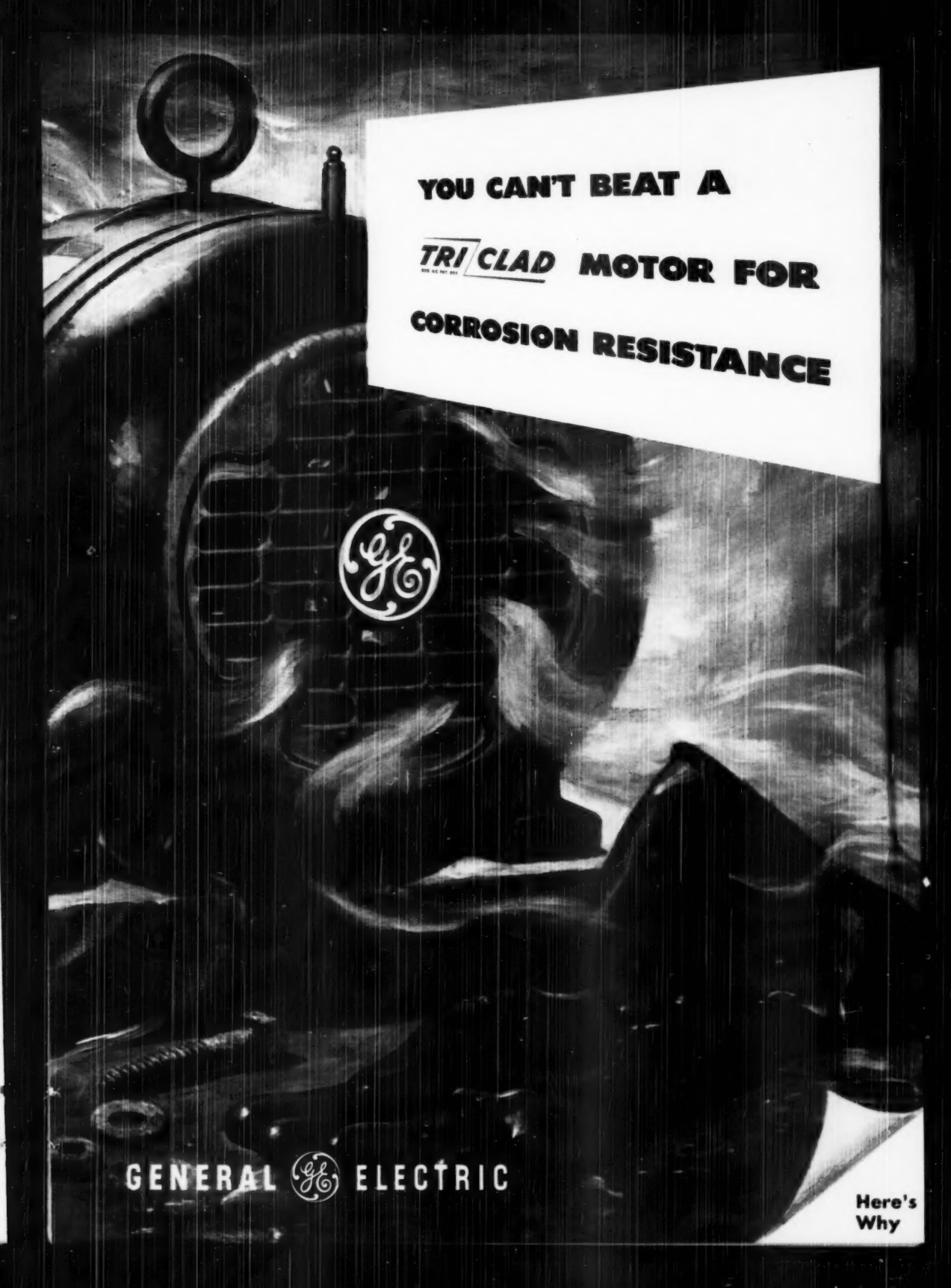
the Nation's Headquarters for
BRASS & COPPER

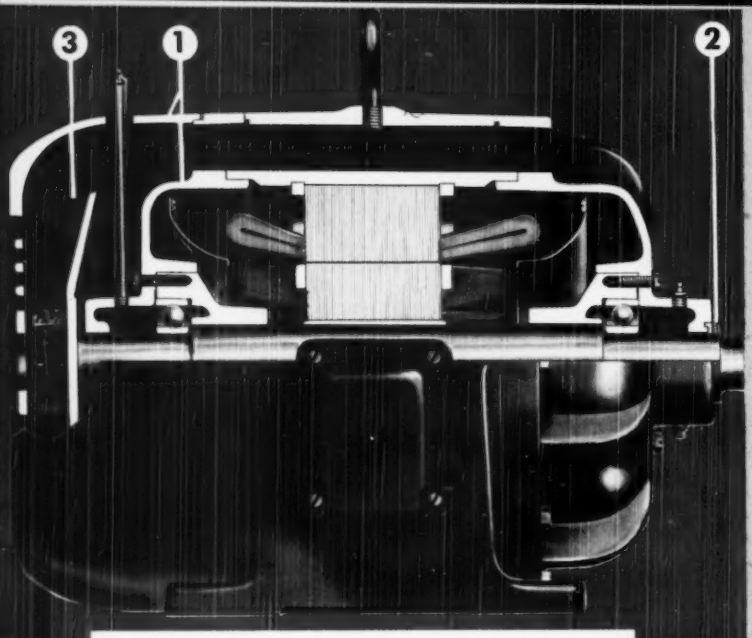
WATERBURY 20 CONNECTICUT

SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA BALTIMORE† BOSTON CHICAGO CINCINNATI† CLEVELAND DALLAS DENVER† DETROIT† HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE† MINNEAPOLIS† NEWARK NEW ORLEANS† NEW YORK PHILADELPHIA† PITTSBURGH† PROVIDENCE† ROCHESTER† ST. LOUIS† SAN FRANCISCO† SEATTLE† WATERBURY †Sales Office Only


YOU CAN'T BEAT A
TRI CLAD MOTOR FOR
CORROSION RESISTANCE
GENERAL ELECTRIC
Here's
Why



Here's the totally enclosed Tri-Clad double-shell structure (1) that locks out dirt, flying metal chips, abrasive dust and corrosive fumes. Check the rotating labyrinth seal (2) which prevents foreign matter from working in along the shaft. Note the cast-iron housing, the corrosion-resistant G-E Textolite* material cooling fan (3). Fan circulates cooling air between the shells—no contaminated air touches the punchings or inside parts.

You can't beat TRI/CLAD motors for corrosion resistance

Acid fumes, alkali dust, dye-house vapors, tropical weather – you name *your* motor "poison." You just can't beat Tri-Clad cast-iron construction for corrosion resistance.

Rolling up 6 billion hours of service on all kinds of jobs, more than 1,876,000 Tri-Clad motors tell the eye-opening story of cast-iron motor structure. You get an inherent damping action that minimizes noise and damaging vibration. You get rigidity that makes for permanent shaft alignment. (Try bolting a Tri-Clad motor to an uneven surface – the bolt will snap before you can twist the rigid frame out of line.) You get extra protection against jarring blows and rough handling. You get resistance to rust and corrosion that is not approached by any other metal used for standard motor construction today.

WANT MOTORS THAT STAY ON THE JOB ANWYHERE? There's a stock of Tri-Clad motors near you, in nearly all types and ratings, ready for **IMMEDIATE SHIPMENT**. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

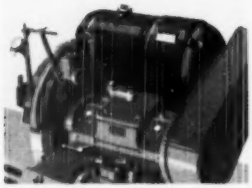
*Reg. U. S. Pat. Off.

(standard on popular sizes)

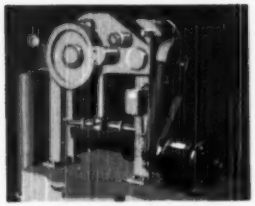
GENERAL ELECTRIC

YOU CAN'T BEAT TRI/CLAD EXTRA PROTECTION

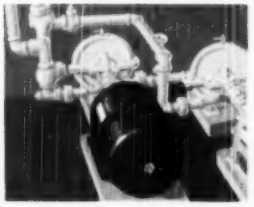
G-E capacitor motors for use on fans, blowers, pumps and compressors with single-phase power. From ¾ to 5 hp.



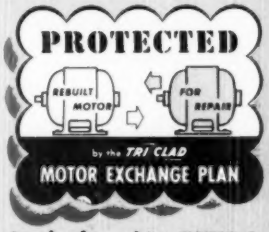
G-E Type ACA induction motors for adjustable speeds—provide speed ranges from 3-1 to 20-1. From 3 to 75 hp.



G-E open (dripproof) induction motors for constant-load, constant-speed applications. From 1 to 2000 hp.



G-E totally enclosed motors for outdoor operation, in abrasive dusts, or corrosive fumes. From 1 to 1000 hp.



Look for this **EXTRA** on the motor you buy!

DUQUESNE LIGHT COMPANY'S Frank R. Phillips Power Station at Wireton, Pa. Units 2 and 3, now being constructed by Dravo, will more than triple the original 75,000 kw capacity of this key station serving the Pittsburgh area.

DRAVO
CORPORATION

DRAVO BUILDING, PITTSBURGH 22, PA.

Engineering Constructors of power plants, boiler plants, central stations, compressor stations, water pumping stations—fabricators and erectors of power piping—power and boiler plant equipment

PITTSBURGH • PHILADELPHIA • CLEVELAND • NEW YORK • DETROIT

...FOR Steel Valves

Fig.1938-WD6
300 lb. CAST STEEL GATE

Body and bonnet are of Carbon Molybdenum Steel. For steam, water, gas and air service, disc and stem are stainless steel, with high tin content nickel alloy seat rings—a fine-wearing combination developed by Lunkenheimer.

For oil and corrosive service, valves are furnished with stainless steel stem, disc faces and seat rings.

Lunkenheimer design and construction insure all the essentials for satisfactory and low-cost service.

Fig. 1751
150 lb. S.P.GATE
Carbon Steel Body and Bonnet

A battery of heavy duty universal turret lathes, typical of Lunkenheimer's continuous modernization program, machining Steel Valve bodies. New equipment of all kinds; the latest in valve metallurgy and design; plus traditional Lunkenheimer craftsmanship, assure continually improved products which mean better, lower-cost valve service.

YOU CAN'T GO WRONG ON LUNKENHEIMER!

This mark on steel valves is your assurance of highest quality

THE trend toward wider use of steel valves for many services makes Lunkenheimer, who pioneered the development and production of high pressure-high temperature designs, a logical and dependable source of supply.

Here you have top metallurgical research, sound engineering knowledge and design, advanced foundry methods under rigid control in our own steel foundry, most modern tools and manufacturing equipment, plus wide experience, to guide you in the selection of your requirements.

The valves illustrated are but two of a complete line of steel valves for every industrial purpose. Available in a variety of alloys and trims to suit specific applications . . . gate, globe, angle and check patterns, 150 lb. to 2500 lb. and higher pressures; screw, flange or welding ends. Complete information is given in Steel Valve Catalog No. 553, available on request.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO, U.S.A.

NEW YORK 13 • CHICAGO 6 • BOSTON 10 • PHILADELPHIA 34

EXPORT DEPT. CINCINNATI 14, OHIO, U.S.A.

Helpful Service at Your Call...

Lunkenheimer representatives and sales engineers will be glad to work with you on any problem of valve installation and usage. And for your immediate maintenance requirements, call your Lunkenheimer Distributor. He is well qualified to take care of your needs.

Leadership through Achievement!

"We stopped both useless shutdowns and motor burnouts from Single Phasing by installing Fusetron fuses in a refrigeration compressor circuit"
Glenn F. Buschman, Manager
Kirby Risk Electric Motors, Inc.
Lafayette, Ind.

Mr. Buschman continues—

"In December '47 we rewound a motor for the Rund Packing Company of Lafayette, Indiana that had been burned out on single phase.

"One week later the same motor came back, again burned out on single phase.

"We investigated and found that the motor was used on the refrigeration compressor and that starting currents were causing the 100 amp. 250 volt renewable fuses protecting the circuit to blow. When one of them blew it single phased the motor.

"The thermals in the starter were oversize and so the motor burned up.

"100 amp. FUSETRON dual-element fuses were installed in place of the ordinary fuses and the thermals changed to the proper size.

"The thermals have so far never had to operate because the FUSETRON dual-element fuses stopped the useless blows on the starting current. This automatically stopped the single phasing that had previously caused the motor burnouts."

FUSETRON FUSES GIVE 10-POINT PROTECTION

TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION

BUSS

★ Fusetron fuses have high interrupting capacity. Tests conducted by the Electrical Testing Laboratories of New York City in December 1947 showed that on a 240 volt 60 cycle 3 phase, 4 wire circuit set to deliver 50,000 amperes, 30, 60, 100, 200, 400 and 600 ampere 250 volt Fusetron fuses on each and every test cleared the circuit without belching flame and with comparatively little noise.

1. ★Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

Fusetron DUAL ELEMENT Fuses

Give All-Purpose Protection

because . . .

The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

Don't Risk Losses

One needless shutdown
One lost motor
One destroyed switch or panel

may cost you far more than replacing every ordinary fuse with a FUSETRON dual-element fuse

MAIL THE COUPON NOW
for complete information about Fusetron Fuses and their 10-point all-purpose protection

Bussmann Mfg. Co., University at Jefferson St. Louis 7, Mo.
(Division McGraw Electric Co.)

Please send me complete facts about FUSETRON Dual-Element FUSES.

Name .....

Title .....

Company .....

Address .....

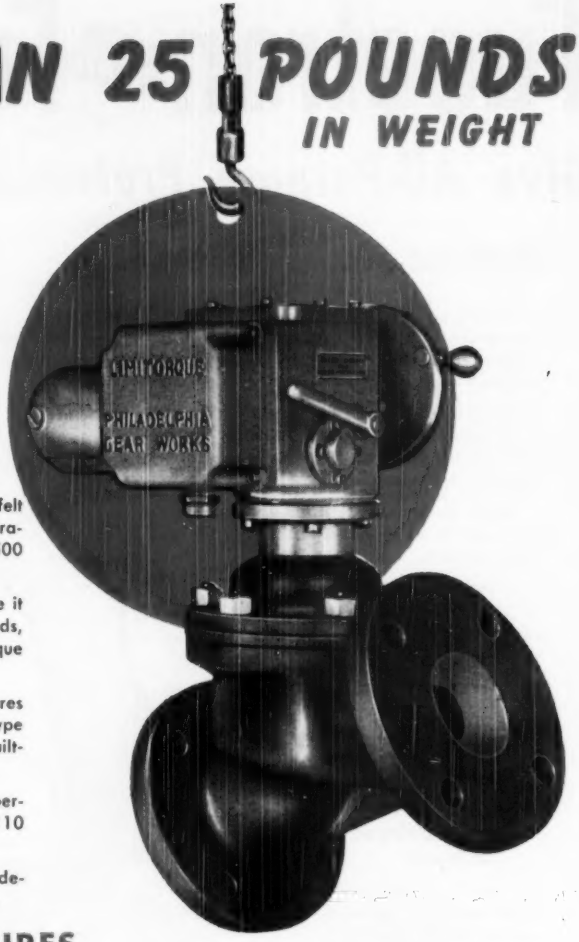
City & Zone ..... State .....

750

LESS THAN 25 POUNDS IN WEIGHT

THE *NEW* PHILADELPHIA TYPE SM-OO LIMITORQUE VALVE CONTROL

FOR SMALLER VALVES



This new Philadelphia development fills a long felt need—a low cost control unit for the remote operation of smaller valves—4 inches or less—under 500 p.s.i. pressures and temperatures up to 800°F.

The Type SM-OO is really a "little giant"—while it is extremely compact and weighs under 25 pounds, its specially designed high speed, high starting torque motor will develop a thrust of 500#.

All the widely used standard LimiTorque features have been incorporated into the design of the Type SM-OO (see below) . . . it is not in any way "built-down" to meet a price.

These units are normally supplied with motors operating on single phase, 110 Volt house current or 110 Volt D-c.

A special compact control enclosure has been developed especially for use with the Type SM-OO.

CHECK THESE FEATURES

1. *Micrometer torque seating switch.*
2. *Self contained unit—no gears, nut or bearings to buy.*
3. *Weatherproof, dust-tight and watertight.*
4. *Hammerblow device, which permits motor to attain full speed before encountering load.*
5. *Non-rotating handwheel built into unit for rapid manual opening or closing of valve.*
6. *Automatic declutch mechanism disengages handwheel when unit is under motor operation.*
7. *High torque motors.*
8. *Simple valve yoke.*

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON

IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

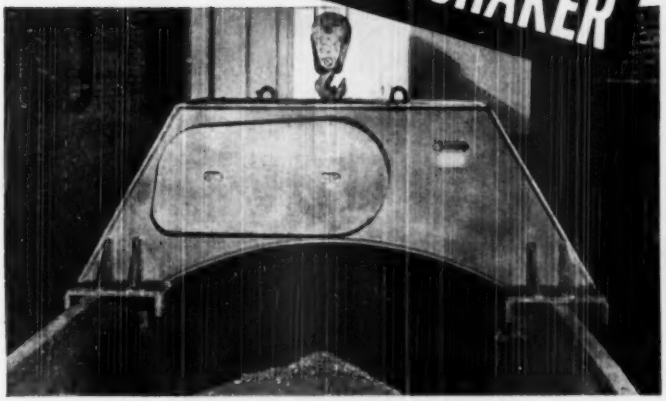
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

CUT COAL UNLOADING COSTS 2 WAYS

ALLIS-CHALMERS CAR SHAKER

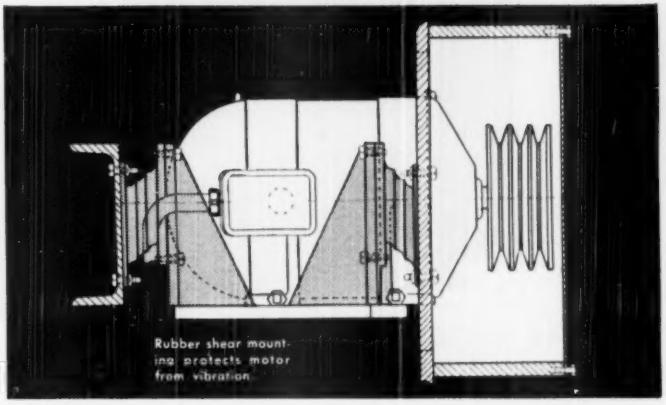
1. SAVE MAN-HOURS

In just a few minutes a hopper-bottom carload of coal screenings can be emptied with the new Allis-Chalmers Car Shaker. Labor is saved at the unloading station. Expensive demurrage costs may be avoided!



2. SAVE MAINTENANCE

Simplified mechanism has minimum of working parts to maintain. Driving motor is 15 hp, high-torque, totally-enclosed... mounted on rubber to protect against vibration! (Note rubber motor mount at right) Steel body is stress-relieved.



Rubber shear mounting protects motor from vibration

HERE'S A CAR SHAKER that is built to withstand severe vibration necessary for fast unloading of bridged and packed coal from hopper-bottom cars.

Its simplified mechanism . . . its unique arrangement for hydraulically removing self-aligning bearings for replacement purposes . . . and *many* other features pay off in low maintenance and long service!

Bulletin 07B7221 gives you more facts. Contact your nearby Allis-Chalmers Sales Office. Or send in the handy coupon.

ALLIS-CHALMERS, 952A SO. 70 ST. MILWAUKEE, WIS.

A-2909

Please send Car Shaker Bulletin 07B7221.

Name.....

Title.....

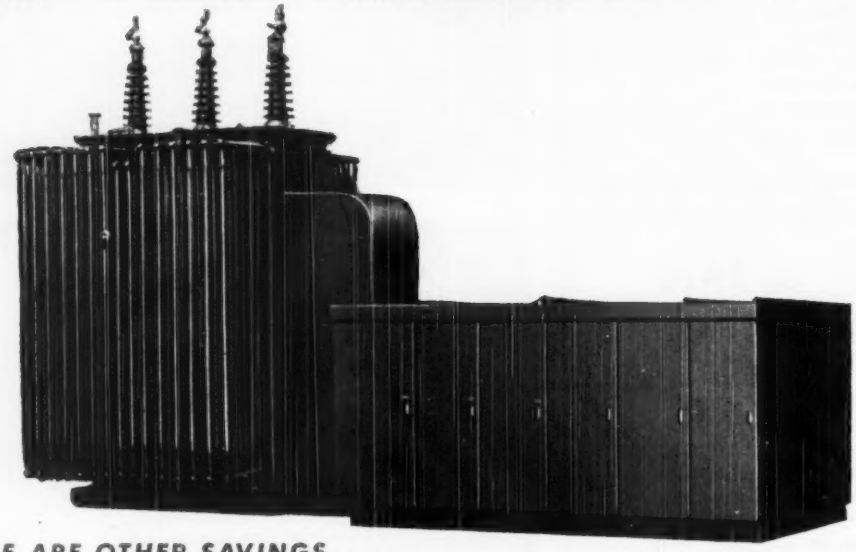
Firm.....

Address.....

ALLIS-CHALMERS

UNIT SUBSTATION

over FIELD-ASSEMBLED TYPE



Typical G-E Master Unit Substation

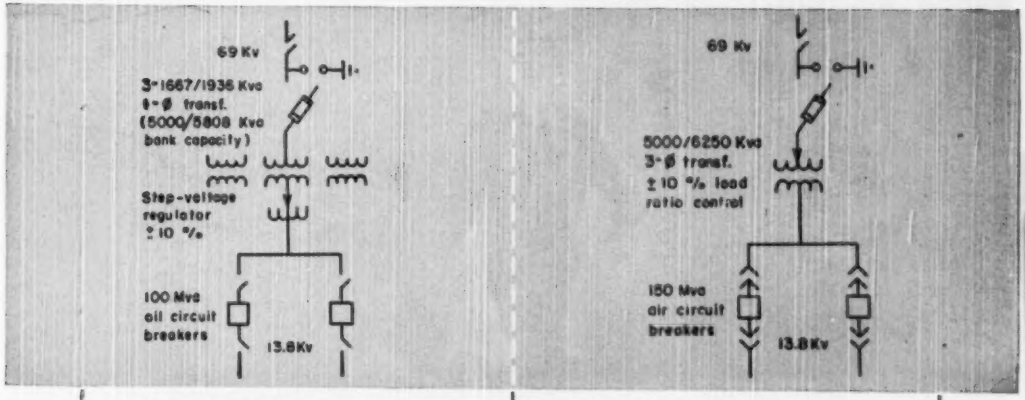
HERE ARE OTHER SAVINGS.....

When you order General Electric Unit Substations your engineering involves only a simple one-line diagram like the one at the right. We do all the detailed specs, prepare construction drawings, electrical diagrams, operating instructions and other paper work to give complete co-ordination of the project—all this on one purchase order, and at lower costs than field-assembled types.

For further information ask your G-E Sales Representative for the publications listed or write to *Apparatus Department, General Electric Company, Schenectady 5, New York.*

Master Unit Substations	GEA-3800
Single-circuit Unit Substations	GEA-4300
Package Substations	GEA-4500
Rural Package Substations	GEA-5276

SAVES 8.7%



FIELD-ASSEMBLED TYPE	
MATERIAL AND LABOR	$66,182
OVERHEAD (20%)	13,236
	$79,418

G-E UNIT SUBSTATION	
MATERIAL AND LABOR	$60,424
OVERHEAD (20%)	12,085
	$72,509

SAVINGS by installing G-E UNIT SUBSTATION $6,909 or 8.7%

In this typical cost analysis* that shows the obvious advantage of using General Electric Unit Substations purely from an investment standpoint, the labor estimates on both jobs were the minimum, a factor that favored the field-assembled type. As G-E Unit Substations arrive in large, completely-assembled units they are installed faster and easier, with lower labor costs.

Note that 20% overhead was added in both cases. For a comparison of *real costs*, 10% on the G-E Unit Substation against 20% on the field-assembled type would be more reasonable. Overhead is reduced when you order G-E Unit Substations because weeks spent in tedious engineering and detailing individual items are eliminated, at definite savings to you. Another item in favor of the G-E Unit Substation is its fan-cooled rating—442 kva greater than the field-assembled job. At a conservative $5 per regulated kva this gives you further savings in favor of the Unit Substation.

*For one installation in 1949.

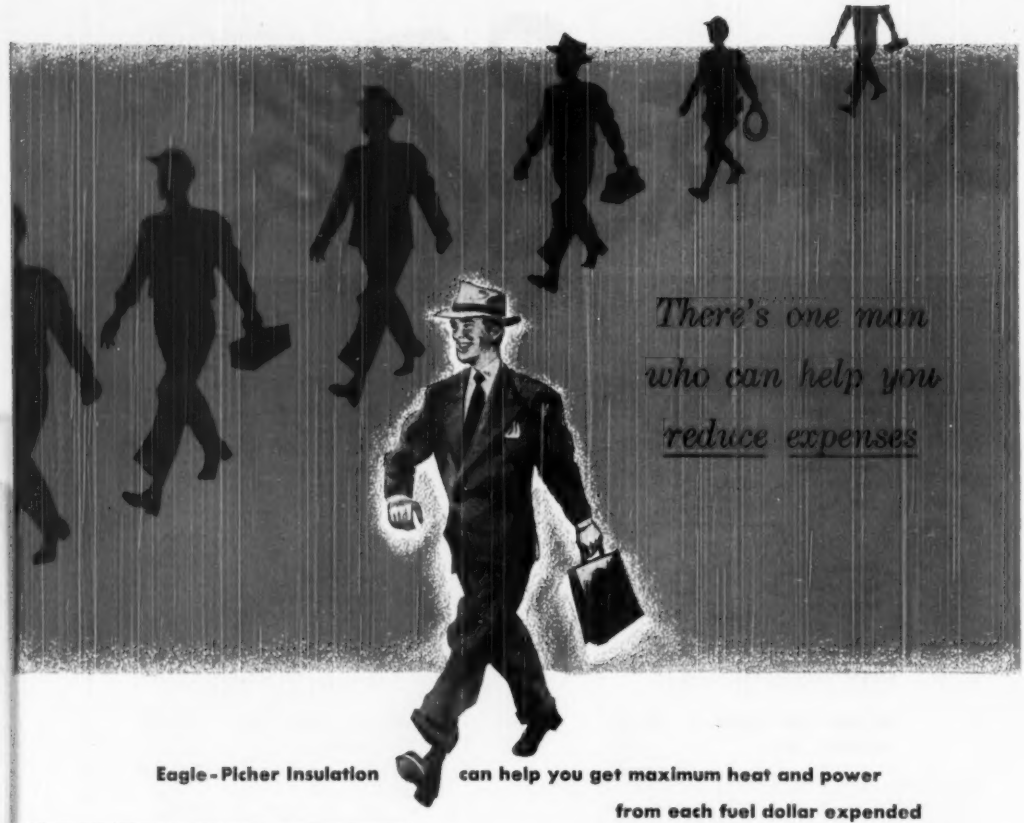
MATERIAL AND LABOR	$66,182
OVERHEAD (20%)	13,236
EXTRA FAN-COOLED CAPACITY	2,210
	$81,628

LET'S EVALUATE

MATERIAL AND LABOR	$60,424
OVERHEAD (10%)	6,042
	$66,466

SAVINGS by installing G-E UNIT SUBSTATION $15,162 or 18.6%

GENERAL ELECTRIC



Eagle-Picher Insulation can help you get maximum heat and power from each fuel dollar expended

Here's insulation that will save you money

EAGLE-PICHER DE-85 BLOCKS

A highly efficient, rigid-type insulating material composed almost entirely of pure, lightweight, Eagle-Picher Diatomaceous Earth. High physical strength enables these blocks to stand up under usage normally encountered in installation. Adaptable to virtually all types of heated equipment. Can be cut with a knife, or sawed, to fit irregular shapes. DE-85 Blocks for temperatures to 1300°F. DE-95 Blocks for temperatures to 2000°F.

EAGLE-PICHER "99" FINISHING CEMENT

Finishing cement for temperatures up to 1000°F. Adheres tightly to hot or cold surfaces with practically no shrinkage. Highly durable. Gives a smooth, hard, light-colored, paintable surface.

EAGLE-PICHER STALASTIC
(Boiler Wall Coating)

Effectively seals against air infiltration through boiler settings — seals cracks and pores, effects substantial fuel savings. Great adhesive strength, retains its elasticity. For temperatures up to 400°F.

An Eagle-Picher Industrial Insulation distributor or representative can help you reduce operating expenses because he has available a wide line of insulation products — for high and low temperatures — scientifically designed for maximum thermal efficiency, and practical application. Why not let him give you more information about some of the products listed here?

These Eagle-Picher products can save you money . . . power . . . time

Insulating Felts • Supertemp Blocks • Blankets
Loose Wool • Pipe Covering • Stalastic • Insulseal • Insulstic
Swetchek • Finishing Cements • Insulating Cements
Fireproofing Cement • Diatomaceous Earth Blocks

THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool — for a full range of high and low temperatures. Technical data on request.

EAGLE EP PICHER

Since 1843

2100 - 3101

Get maximum fuel savings and exact temperature control with these versatile, efficient insulations

EAGLE-PICHER SUPER "66" INSULATING CEMENT

Super "66" is all-purpose, rust-inhibitive, extremely adhesive insulating cement. "Springy ball" pellets don't collapse after application . . . give great coverage, retain their thermal efficiency. 100 lbs. covers 65 sq. ft.—1 inch thick! Easily applied with trowel, over flat and irregular surfaces. Efficient for temperatures up to 1800° F. Reclaimable when used on equipment whose temperatures go up to 1200° F.

EAGLE-PICHER SUPERTEMP BLOCKS

Eagle-Picher Supertemp Blocks are lightweight (approximately 16 lbs. per cu. ft.). Can be cut easily with knife or saw to fit off-shaped areas . . . they fit snugly over minor irregularities. They're strong and have high refractory value. Withstand temperatures up to 1700° F. Conductivity at 512° F. approximately 0.43 . . . all standard sizes, from 3" x 18" to 12" x 36" . . . in thicknesses from 1" to 4".

For a completely effective, low-cost insulation combination, you can't beat the teamwork of Eagle-Picher Supertemp Blocks, Diatomaceous Earth Blocks #85 (for temperatures to 1300°F.) and DE Blocks #95 (for temperatures to 2000°F.), Eagle-Picher Super "66" Insulating Cement, and Eagle-Picher Insulseal. They work effectively to give your equipment the highest possible thermal efficiency . . . cut operating costs by saving maximum amount of fuel . . . and help to provide perfect, precise control over temperatures.

EAGLE-PICHER INSULSEAL

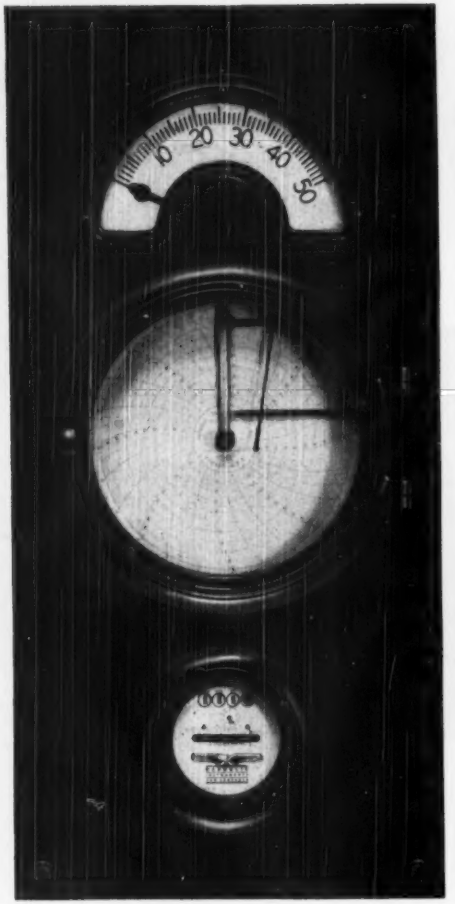
A tough, weatherproof, protective coating for insulation. For temperatures up to 450° F. Applied as a plastic, its smooth troweling qualities assure uniform coverage, proper thickness. It protects insulation from air infiltration, fumes, rain, snow, vibration, punctures, and withstands severe service, indoors or out. Dries to a smooth, rich black, has a neat appearance on hot or cold surfaces . . . may be washed or painted.

THE EAGLE-PICHER COMPANY General Offices: Cincinnati (1), Ohio

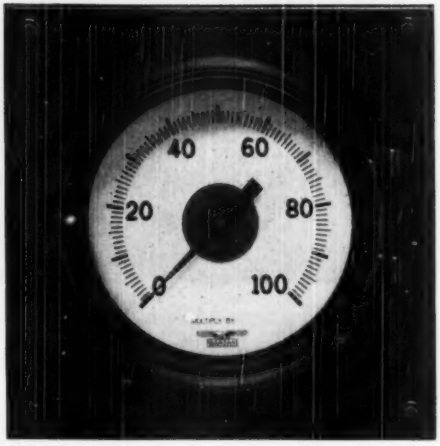
Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

EAGLE EP PICHER *Since 1843*

Varying flows because the



Indicator-Recorder-Integrator



Indicator

The Republic flow integrator, being of the modified watt-hour type, totalizes continuously —not intermittently. It operates independently of the recorder and its accuracy is not dependent on or affected by any clock mechanism or mechanical action.

The Republic meter is, on this account, peculiarly fitted to follow all changes in flow rate and accurately measure highly fluctuating flows.

ALL TYPES OF FLUIDS

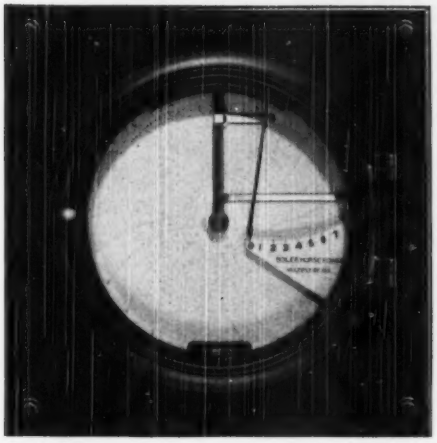
Republic electric type flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for metering fluids at line pressures up to 5,000 lb. per sq. in. and for all ranges of differential pressure. The reading instruments — indicator, recorder and integrator—are of the remote reading type and can be located any distance from the point of flow measurement.

ANY COMBINATION

While each Republic reading instrument is standard in design and construction each is especially calibrated for the particular flow measurement for which it is specified. Any reading instrument, indicator, recorder or integrator, may be obtained separately or in any

are accurately totalized

integrator is continuous



Recorder

Integrator

combination desired, making possible the highest degree of flexibility in plant use.

SIMPLE IN OPERATION

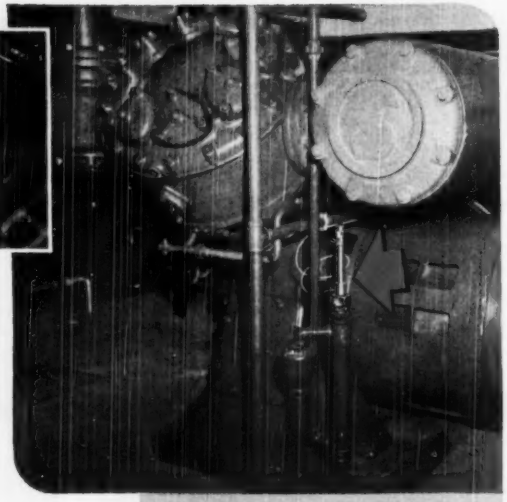
The Republic electric meter is the only flow meter commercially manufactured which is strictly electric in its operation. All other types of so called electric meters use the motion of the mercury to move a float or produce a force which is then converted into an electrical value which is in turn transmitted to a receiving or reading instrument. In the Republic meter, the transmitted electrical value is determined directly by the mercury motion, thus eliminating one of the steps in the sequence, and simplifying the mechanism to that extent. Their are no floats, levers, cams, rotating shafts or anything else to interfere with the unimpeded movement of the mercury, which has no work to perform, but merely fulfills the function of making contact.

NEW DATA BOOK

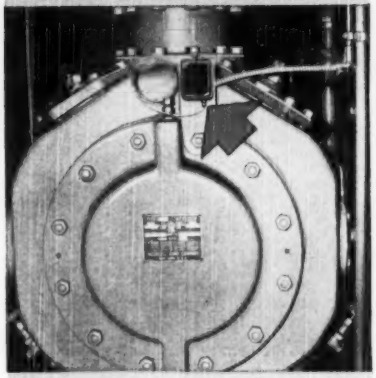
Just off the press—a completely new data book describing and illustrating, in detail, the operating features of the Republic Flow Meter and its many applications. Write for your copy of Data Book No. 702—there is no obligation.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

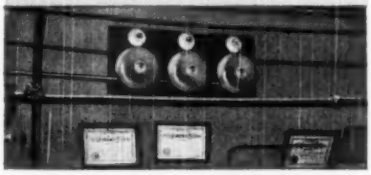
2/3 OF COOLING WATER *Saved!*



The Engineer at The Harvey Metals Corp. is well pleased with the Sarco TR-21 cooling control on this big compressor in Chicago. And so is the management because up to ⅔ of the metered water used for cooling is now saved. The engineer says: "With several thousand dollars tied up in a compressor, you are going to open up the cooling line wide and play safe, unless you have cooling control. Yes, we use the warm water too, but it used to overflow the hot well continually."



Bell rings and red light flashes when compressor cooling water gets too hot.



OTHER SARCO COOLING CONTROLS

When you merely want to protect the engine or compressor and don't care about the water there are several Sarco combinations available. You can put a high limit control on the compressor which will flash red lights and ring the gong when danger is near. Or you can just put on a Sarco Control that shuts down the compressor when the water gets too hot. For smaller compressors and vacuum pumps, the Sarco TR-40 Cooling Control is inexpensive, goes into the line like a T and is saving up to 50% of the water on many jobs.

ASK FOR BULLETIN No.700 ON SARCO COOLING CONTROLS

273

SARCO SAVES STEAM

SARCO COMPANY, INC.

Represented in Principal Cities

Empire State Building, New York 1, N. Y.

SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

The TERRY TURBINE

TURBINES FOR *Air Conditioning* AT MADISON SQUARE GARDEN

In 1925 Madison Square Garden installed three Terry Multi-Stage Turbines to drive air conditioning and refrigeration compressors. These units deliver 290 hp at 3500 rpm with steam conditions of 100 psi exhausting to a 26 in. vacuum.

After 22 years experience Madison Square Garden installed three more Terry Multi-Stage Turbines, one of which is shown above. This unit delivers 330 hp, at 5650 rpm, with steam at 100 psi exhausting to a 25 in. vacuum.

The same engineering talent and manufacturing facilities that produced these turbines are available to assist you in obtaining efficient power generation.

Any of our District Representatives will be pleased to give you full information on a turbine drive for your requirements. No obligation. May we send you descriptive bulletin?

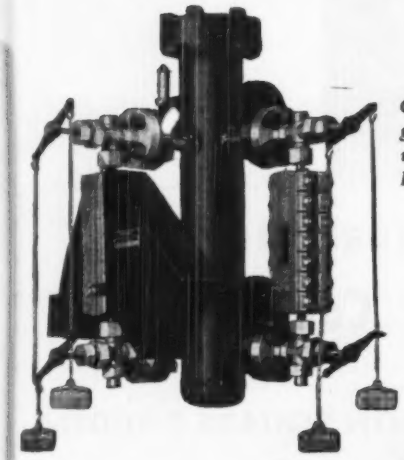
TT 1184

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

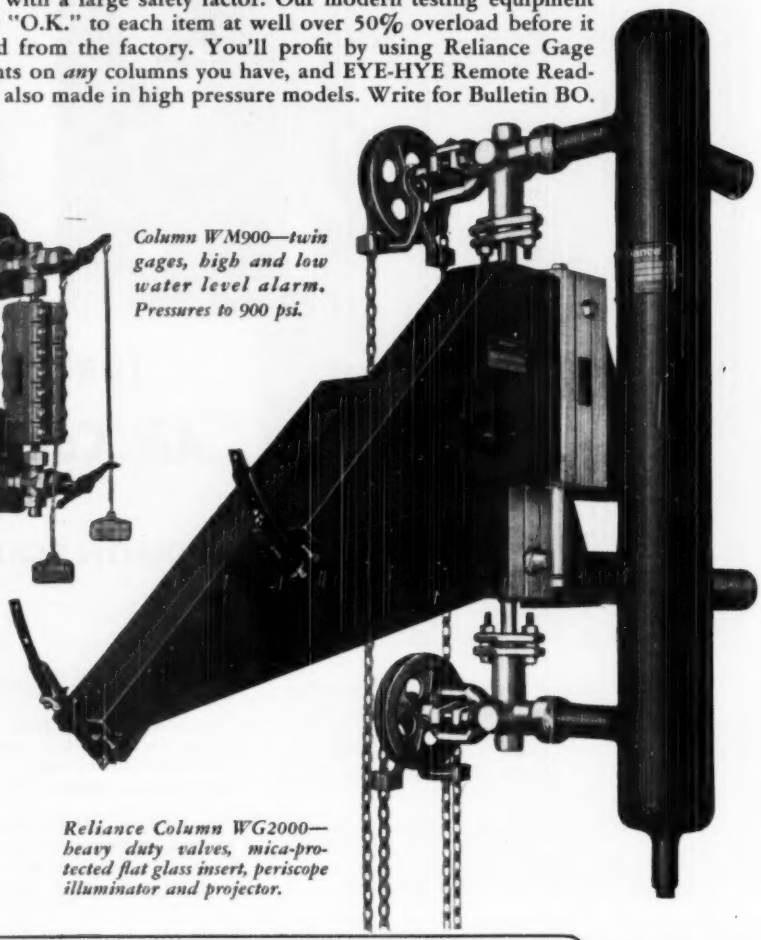
Protect your high pressure plant

with Reliance super-rugged columns and water gage equipment.

THE extra margin of safety you like to be sure of in high pressure equipment is generously built into Reliance Water Columns and Gages. For accident-preventing low-maintenance "boiler trim", Reliance supplies sturdy welded forged steel construction rated to 2000 psi, with a large safety factor. Our modern testing equipment has to say "O.K." to each item at well over 50% overload before it is released from the factory. You'll profit by using Reliance Gage components on *any* columns you have, and EYE-HYE Remote Reading Gage, also made in high pressure models. Write for Bulletin BO.



Column WM900—twin gages, high and low water level alarm. Pressures to 900 psi.



Reliance Column WG2000—heavy duty valves, mica-protected flat glass insert, periscope illuminator and projector.

Water Columns
Gage Valves
Flat Glass Inserts
Micasight Inserts
Direct-to-drum Assemblies
EYE-HYE Remote Reading Gage

BOILER SAFETY DEVICES since 1884

Reliance

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

full branch tees

½ INCH THROUGH 30 INCHES

TO MARK PROGRESS

ANOTHER IMPORTANT DEVELOPMENT in the LADISH LINE of

Controlled Quality **FITTINGS**

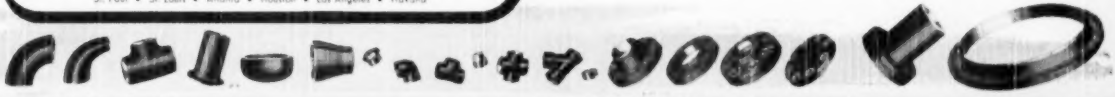
THE COMPLETE FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

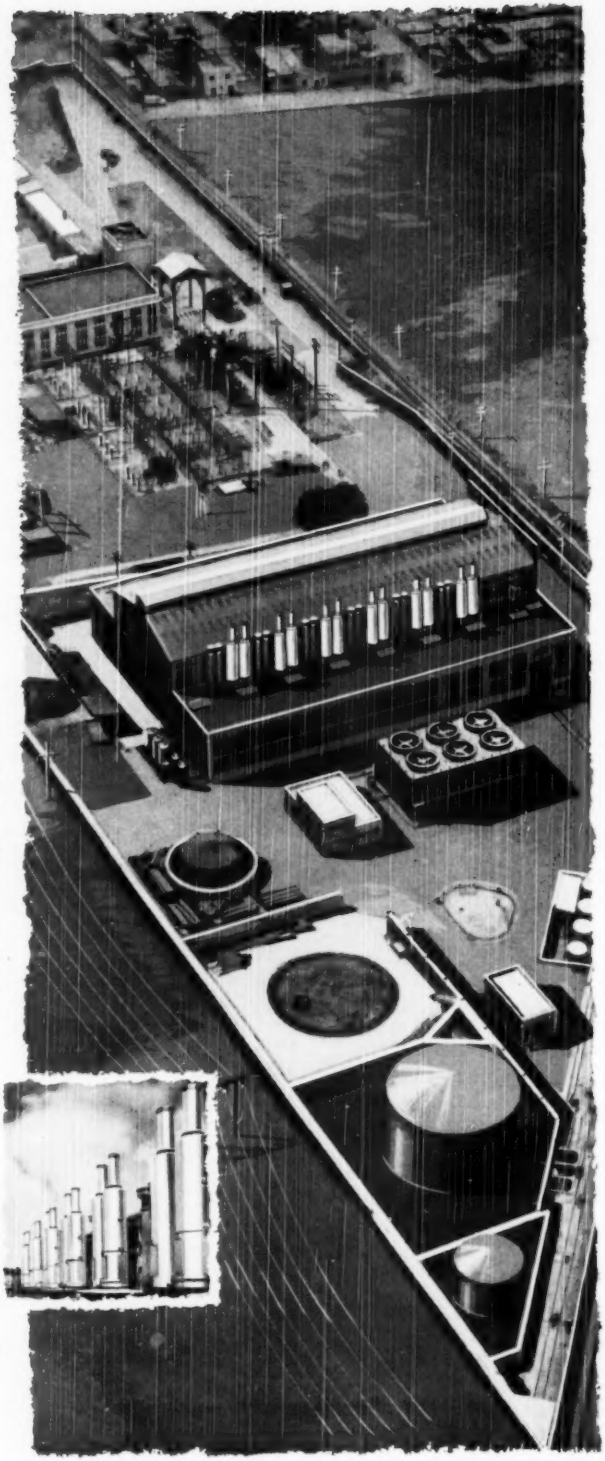
CUDAHY, WISCONSIN
MILWAUKEE SUBURB

DISTRICT OFFICES: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago
St. Paul • St. Louis • Atlanta • Houston • Los Angeles • Havana

To increase safety, ease of installation and welding accessibility . . . Ladish Welding Tees have Full Branch Outlets with identical center-to-end dimension of branch and run as is required for each size *through 30 inches.* Scientific metal distribution . . . pioneered by Ladish . . . adds extra protection by equalizing stress over the entire fitting and assuring maximum strength in every cross section.



Largest Diesel Powered Electric Utility Plant in the Americas has no *Diesel Noise Problems*



Snub the Slug and Stop the Noise

The Tacubaya, Mexico City, plant, one of the largest Diesel electric power plants in operation, solved its engine noise problem with Burgess-Manning Snubbers. The six Nordberg Diesels delivering a total of 44,100 hp at Mexico City altitude, are each equipped with two Burgess-Manning Intake and two Exhaust Snubbers to effectively reduce intake and exhaust noise.

The Snubbers prevent noise by smoothing the flow of intake air and dissipating the energy in the exhaust gas slugs, providing quiet operation without affecting performance.

Originators of the snubbing principle, and with over twenty years of design experience, the Burgess-Manning Company is well staffed to solve your engine exhaust and compressor intake noise problems. Let us submit recommendations.

BURGESS-MANNING COMPANY
LIBERTYVILLE, ILLINOIS

Call in this Remarkable Instrument

TO INCREASE POWER OUTPUT AT NO INCREASE IN COST

THE Cities Service Industrial Heat Prover is a flue gas analyzer which quickly, accurately and completely determines the heat generating efficiency of equipment using any type of fuel. With this information necessary adjustments to increase efficiency can be made.

A complete new line of petroleum products for the power field including:

- **D-C Diesel Engine Oils**
- **Pacemaker, Turbine and Compressor Oils**
- **Optimus Cylinder Oils**
- **Sentry Plant Machinery Oils**

The Heat Prover gives you the answers to these questions important to efficient production:

1. **How much energy is wasted in uselessly heating excess air?**
2. **How much excess oxygen is present in furnace gases?**
3. **What percentage of fuel is converted into useful heat?**

For a complete description of Cities Service Industrial Heat Prover Service, mail the coupon below for your copy of "Combustion Control for Industry."

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

CITIES SERVICE OIL CO.
Sixty Wall Tower, Room 636
New York 5, N. Y.
Please send me without obligation your new booklet entitled "Combustion Control for Industry."

*Name*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

FOR HIGH EFFICIENCY WITH VARIABLE FAN OUTPUT

THE NEW Sturtevant VANE CONTROL

Sturtevant Vane Control has been universally accepted as the economical way to obtain variable fan output at high efficiency. It combines the advantages of instantaneous regulation of fan output to exact pressure and volume requirements with substantial power savings during those periods when the system does not operate at full rated capacity.

Easily Operable—Vane Control is a simple mechanism which remains easily operable under hot and cold conditions. Notice in the illustration how a cast-iron closure which fastens to the cone of the inlet box completely shrouds the center mechanism from the gas stream.

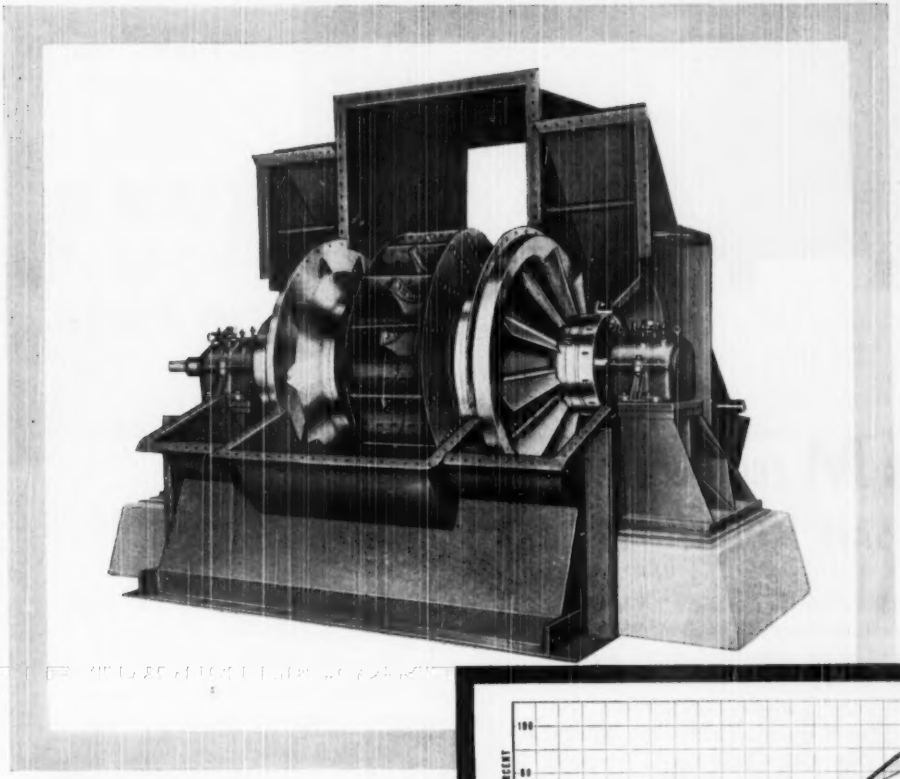
Full Fan Performance—Vanes are pivotted along conical elements to provide sufficient free area to achieve full fan performance when wide open. This conical arrangement of heavy cast or die-formed parts insures extreme rigidity to resist thrust loads.

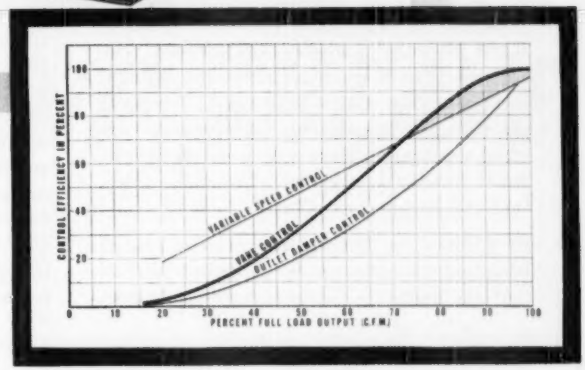
Link and Lever Action—The mechanism operates to give synchronized motion to vanes by link and lever action without the use of gears. Linkage from the operating shaft to the vane center is designed to effect a more rapid motion of vanes in the open range, and a slower motion in the near-closed position where finer adjustment is desired.

No Lubrication—No lubrication is necessary on any of the interior mechanisms of the control. Arrangement permits easy accessibility of all parts for inspection and maintenance.

For full information on Vane Control, write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.

Cutaway of a Sturtevant Induced Draft Fan, showing Vane Control shielded from the gas stream but open to access from the outside, and the Sturtevant E-R (Erosion Resisting) Wheel.



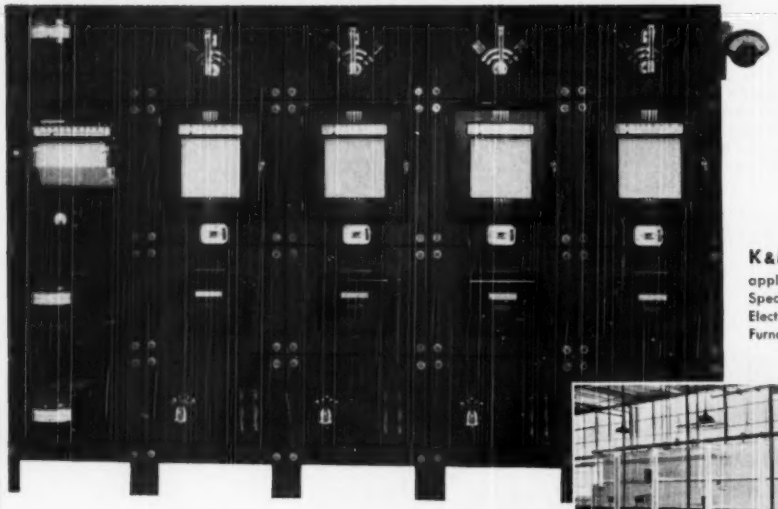


The comparison of control devices can best be shown by the relative "efficiencies" of the controls. Notice the "plus" region of Vane Control shown by the shaded area.

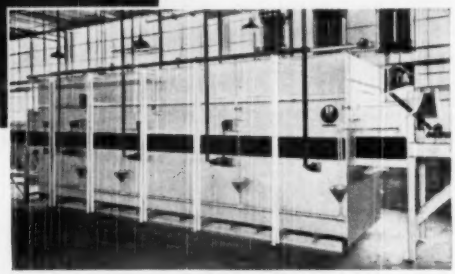
YOU CAN BE SURE...IF IT'S

Westinghouse

J-80192-A



K&M EBONIZED ASBESTOS
applied to control mountings of the Special Atmosphere Roller Hearth Type Electric Furnace, made by The Electric Furnace Company, Salem, Ohio.



K&M EBONIZED ASBESTOS
FOR SAFE MOUNTINGS THAT STAY PUT

The Electric Furnace Company's Special Atmosphere Roller Hearth Type Furnace is modern high-efficiency equipment. Control panels must live up to the same standard. Therefore K&M Ebonized Asbestos was adopted. This advanced K&M electrical mounting material combines unusual dielectric strength, mechanical strength, compactness and shipshape finished appearance. These values endure because K&M Ebonized Asbestos resists shock, vibration and temperature effects.

In addition to lasting serviceability, K&M Ebonized Asbestos means simplified production and assembly. Time savings result from the easy handling and cutting; the quick, clean machining and drilling.

The all-around utility of K&M Ebonized Asbestos is based on the proved K&M composition of asbestos fiber and binding cement—pressure-molded to high density, and impregnated with special insulating compound. Thicknesses from $\frac{1}{8}$" to 4" are available, so that engineers and designers are readily able to make a wide range of applications—switchboard mountings—bus bar runs—compartment linings—test tables, bench boards and the like. Full details regarding any uses will be promptly sent on request. Write us.

Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

In Canada — ATLAS ASBESTOS CO., LTD., MONTREAL, TORONTO, WINNIPEG and VANCOUVER

K&M best in asbestos ®

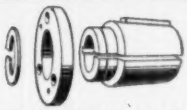
4 BIG ADVANTAGES!

ONE PIECE MOUNTING

Bushing and sheave go on together. One motion mounting. Alignment is easier. Sheave is on right first time.

POSITIVE DRIVE

Bushing is keyed to both shaft and sheave. No slipping. No sheared screws. No jammed bushings from bent screws.



FULL CIRCLE GRIP

Bushing split full length with separate collar. Grips shaft full length around full diameter. No forcing or distortion. Grip easily broken. No hammering.

WIDE SIZE RANGE

Magic Grip sheaves are available from 3" pitch diameter up. Style NC bushing for smaller sizes and Style C bushing for larger sizes.

MAGIC GRIP SHEAVE

YOU CAN MOUNT a *Magic Grip* sheave faster than any other sheave you can buy . . . and demount it just as fast. When you mount a *Magic Grip* sheave it runs true. It will not slip or jam. It always comes off easily.

Even if you don't change sheaves often, you should have *Magic Grip* sheaves on every drive to eliminate the possibility of shaft and bearing damage when ordinary sheaves are hammered or pried on or off.

WIDEST V-BELT LINE

Get everything you need for your V-belt drives from one reliable source. *Texrope* offers the broadest line of V-belts, standard and variable speed sheaves and speed changers in the industry. And you also get the extra engineering skill that comes from having more industrial V-belt installations than any other manufacturer.

Get your copy of the 144 page *Texrope* Pre-Engineered Drive Manual from your A-C Authorized Dealer or Sales Office or write for Bulletin 20B6956.

A-3022

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

Texrope and *Magic Grip* are Allis-Chalmers trademarks.

Sold . . .
Applied . . .
Serviced . . .

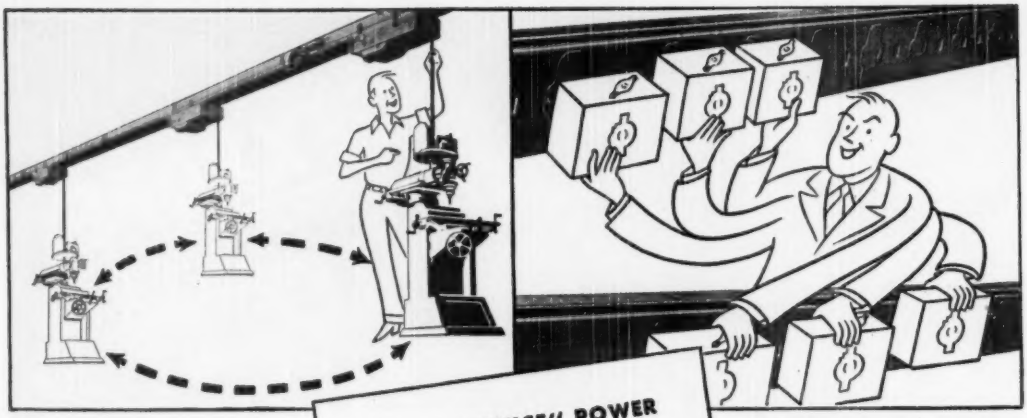
by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

ALLIS-CHALMERS



"CURB SERVICE" POWER KEEPS YOUR ELECTRICAL DISTRIBUTION SYSTEM

Always Flexible

Like a continuous panelboard

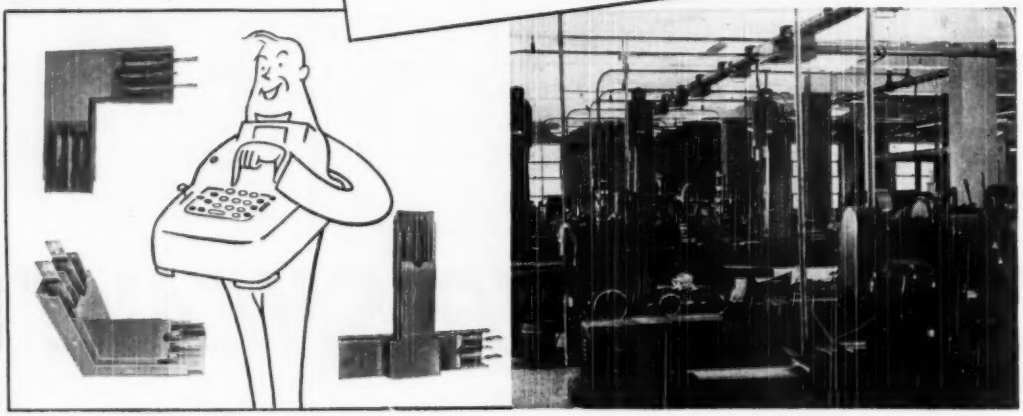
How much time, trouble and money *could* you save if your electric power came off a panelboard running the *entire length* of your plant?

That, in effect, is FVK FLEX-A-POWER® —pre-fabricated busway for 225-1000 amps, 600 volt secondary feeder systems. It's as convenient as curb service —wherever you put a machine, *there's* an outlet.

Relocate loads without rewiring

Every 10-ft section of FVK busway has 15 outlets. You can plug in right at the load . . . rearrange or add loads without rewiring or bothering with extension wires.

Even in cases of major alterations, you can quickly dismantle FLEX-A-POWER, move and reinstall it with practically 100% reuse of materials.



Cheaper to install, too

Standardized parts—straight lengths, elbows, offsets, etc.—delivered to job ready for installation . . . quickly, easily coupled and suspended to conform to any plant layout . . . keep installation time and costs *low!*

Maintenance cost is cut to the bone. Housings resist entrance of dirt and moisture. Materials are made to last.

Remington Rand's Laboratory of Advanced Research at South Norwalk, Conn., saves much time and money by keeping its electrical system flexible. Machinery is quickly relocated without lengthy shutdown. Write for new booklet TEB-4,

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY
Plainville, Conn.

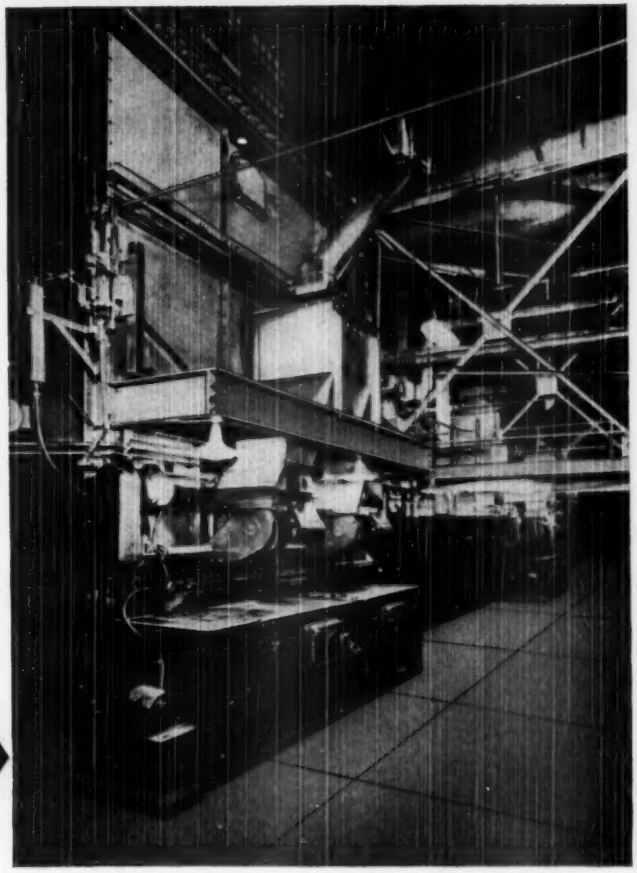
® Reg. Trade Mark

TRUMBULL (T) ELECTRIC

TRUMBULL'S TRAINLOAD OF NEW PRODUCTS

It's even coal distribution that gives peak combustion efficiency

AND AMERICAN PERFECT SPREAD STOKERS GIVE YOU BOTH



Two AE Perfect Spread Stokers recently installed by Marion Power Shovel Company. The boilers, each of 38,000 lbs. per capacity, are Wickes two-drum bent-tube type. Consulting Engineer, Frederick L. Smith. Send coupon for the complete story of this power plant.

SERVICE RECORDS prove that spreader stokers save money wherever installed. They burn almost any coal with remarkable efficiency, including the high moisture, high ash types.

And the AE Perfect Spread Stoker is the best investment you can make in a spreader. Its feeder assures continuous, accurate coal feed, even when coal is wet. Its spiral overthrow rotor *is unique and absolutely superior in distributing coal evenly over the entire grate*. Then, too, the AE engineered cinder reinjection and adjustable overfire air system play important parts in assuring maximum combustion efficiency.

Perfect Spread Stokers come with either continuous discharge, dumping or stationary grates. Capacities range from 8,000 to 500,000 lbs. of steam per hour. Mail coupon for Perfect Spread booklet and the Marion Power Shovel story.

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Car Shakers, Car Pullers

American Engineering Company
2400 Aramingo Ave., Philadelphia 25, Pa.

Gentlemen: We are certainly interested in saving fuel dollars. Send booklet on Perfect Spread Stokers and the story on Marion Power Shovel power plant.

Name ..... Title .....

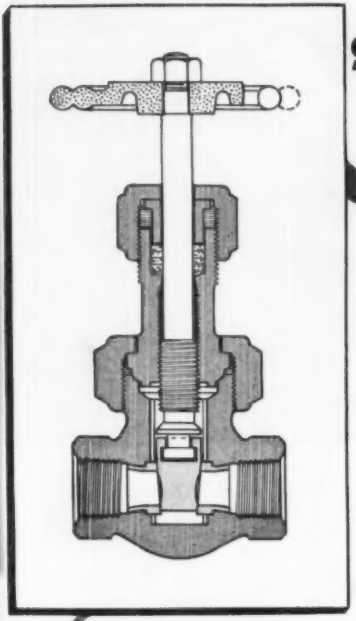
Company .....

Address .....

City ..... Zone ..... State .....

"Where can I get compact, high quality, high pressure Gate Valves for general service?"

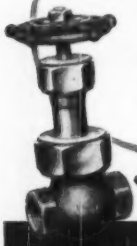
"Order VOGT Series 9850"*



Operating men everywhere rate these valves as tops for general gate valve service including meter and gauge lines, drip and drain lines, etc. Series 9850 valves have drop forged carbon steel bodies and bonnets, rolled in 11½-13% chrome stainless steel seat rings which can be easily renewed, and a solid stainless steel wedge. A ground joint insures tightness between body and bonnet. The stuffing box can be repacked under pressure when the valve is open.

Also available is Series 9750, completely fabricated from 18-8 stainless steel for services where internal or external corrosion is severe.

Series 9850-F8 valves have 18-8 stainless steel trimmings and carbon steel bodies and bonnets.



*Series 9850

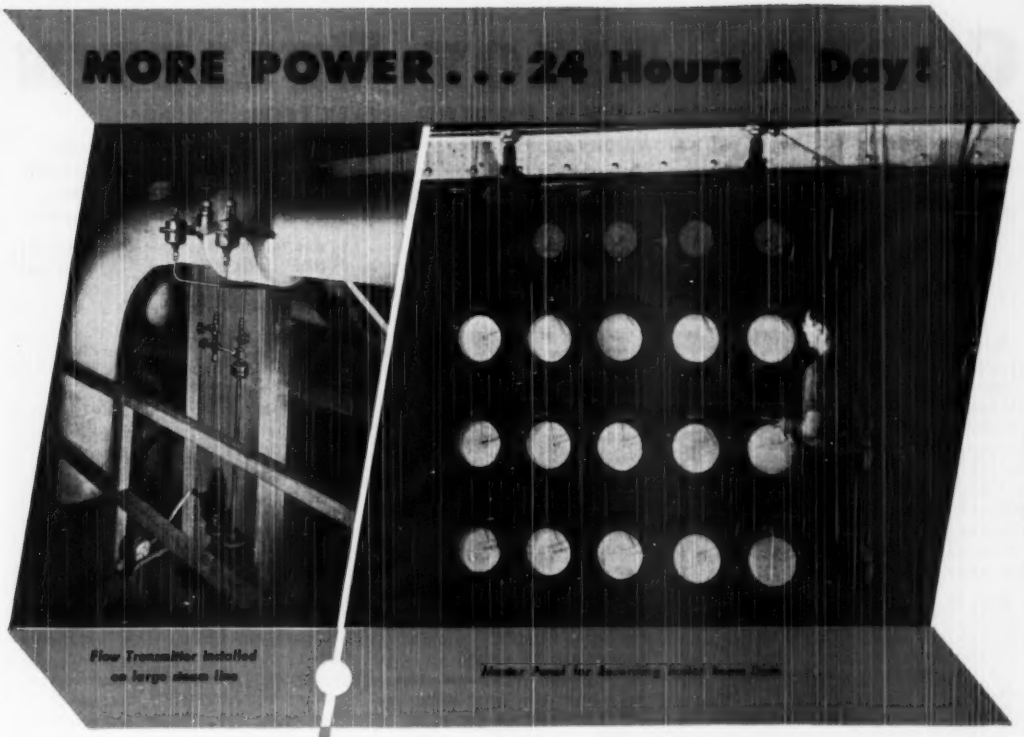
CARBON STEEL } 800 Pounds @ 750° F. 1500 Pounds Cold Non-Shock

For 150-800 pounds general service Union Bonnet • Ground Joint • Inside Screw Stem • Renewable Seat Rings • Solid Wedge — Slotted Type • 11½-13% Chrome Stainless Steel Trimmings Sizes ¼" to 2" inclusive.

HENRY VOGT MACHINE CO.
Louisville 10, Ky.

BRANCH OFFICES: NEW YORK • PHILADELPHIA CLEVELAND • CHICAGO • ST. LOUIS • DALLAS

Vogt DROP FORGED STEEL **VALVES**



Brown Recorders Keep Track of Important Phases of Steam Turbine Operations At Inland Steel Company

More Power at Lower Cost! THAT's the reason why Inland Steel Company recently installed a brand-new 20,000 Kilowatt Steam Turbine Generator!

To check on its efficiency, this company relies on Brown Instruments. The central panel shown above records data pertinent to the operation of the new boilers, water-treating plant and feed-water system. Here are grouped records of such variables as water pressure and temperature, steam temperature and flow, and surge tank levels. It takes but a minute to make sure all equipment is functioning properly.

Such applications are typical of versatile Brown Instruments . . . typical, too, of the know-how Honeywell engineers devote to solving instrumentation problems in all industries. These installations take advantage of new convenience . . . low cost . . . ease of maintenance . . . and interchangeability of parts. Also, an excellent training school is available to customer personnel, tuition free.

In your plant the net result is successful, round-the-clock operation, increased efficiency and economy. For function-fitted, trouble-free instrumentation that pays its way, call in your local Honeywell Engineer . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

FOR BETTER PROCESSING

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Effect of Higher Temperatures on Tube Life

In general, corrosion reactions are speeded up by a rise in temperature. Tests conducted in 3% sodium chloride solutions revealed that the depth of pitting doubles for each 20° C. rise in temperature in the range of 18° to 75° C. The effect of temperature on corrosion rate is influenced by the nature of the corrosion medium—water or other liquid, or gas—and the character of the metal or alloy in contact with this medium.

Why Warm Waters Are More Corrosive

In sea water, a small rise in temperature often leads to a higher rate of corrosion, resulting primarily from greatly increased bacterial activity. With higher temperatures, organic decomposition is more active resulting in the generation of hydrogen sulphide and other odoriferous sulphur and nitrogenous compounds. The presence of even a trace of hydrogen sulphide accelerates the rate of impingement corrosion and changes the character of films of corrosion products.

Records clearly indicate that tube failures during warm seasons, in some localities, are far greater than those encountered during the winter. Condenser tubes installed during the summer often do not develop a satisfactory protective film and consequently may fail prematurely.

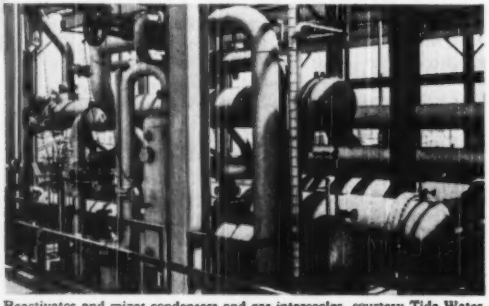
Protection By Scale Formation

In fresh waters, higher temperatures may be responsible for reducing the corrosion rate. With rise in temperature, certain waters precipitate minerals forming a brown or gray protective scale on the tube surfaces in water heaters, exchangers and evaporators. The scale, essentially of calcium carbonate or silicate, may become quite thick.

Evaporation of sea water and fresh waters may lead to concentration of mineral matter to a point where precipitation of thick mineral scales occurs which may build up at rates as high as 0.0625" per month or even higher depending upon the size of coil and amount of water being evaporated. Unfortunately, excessively thick mineral scales interfere with heat transfer properties and must be removed.

Hot Wall Effect

Sometimes severe local corrosion or pitting can rapidly perforate heat exchange tubing on the water or liquid side. Air bubbles or debris separating from the water cling to the metal surface at certain points and act as heat insulators thus allowing small areas to become hotter locally, approaching the temperature of the hot liquid or gas on the other side of the tube wall. Corrosion at these points proceeds at a rate corresponding with this higher temperature. This accelerated corrosion rate is not encountered where the tube surfaces are kept smooth and clean.



Reactivator and mixer condensers and gas intercooler, courtesy Tide Water Associated Oil Company, Bayonne, N. J.

Suggested preventive measures are:

Lower operating temperatures.

Clean tubes immediately when water carries in much debris, mud, silt, rust, etc.

Increase water velocity to help dislodge debris and bubbles of gas.

Feed Water Heaters

Because of the less corrosive nature of the water and the small amount of mineral matter, serious scale formation or deposits are not generally formed in feed water heater tubes. The chief effect of the higher temperature is to lower the physical properties of the metal and increase the creep rate. Higher pressures and temperatures can be handled by tubing with heavier wall thicknesses designed for such service. Cupro Nickel (70-30), because of its low creep rate at higher temperatures, is popular for use in feed water heaters which operate between 500°-600° F.

Performance Records Important

We find that more and more engineers in oil refineries and power plants are keeping careful records of tube life on each condenser and heat exchanger in their plants. Often special units are operated with experimental tubing and piped so that they can be by-passed in order to study the effects of corrosion.

If tubes fail prematurely then studies are immediately started to determine whether the correct alloy has been selected or whether changes in the operating procedures must be made.

Whereas the Admiralty alloy was formerly standard for practically all oil refineries, many are now using Aluminum Brass, Aluminum Bronze or Cupro Nickel, especially if the plants are located on the seaboard where corrosion is excessive.

Engineers who need help on their tube problems can call on Bridgeport's corrosion laboratory. Much information can also be found in Bridgeport's "Condenser Tube Manual" and "Duplex Tubing Technical Bulletin No. 1950", available upon request made on company stationery.

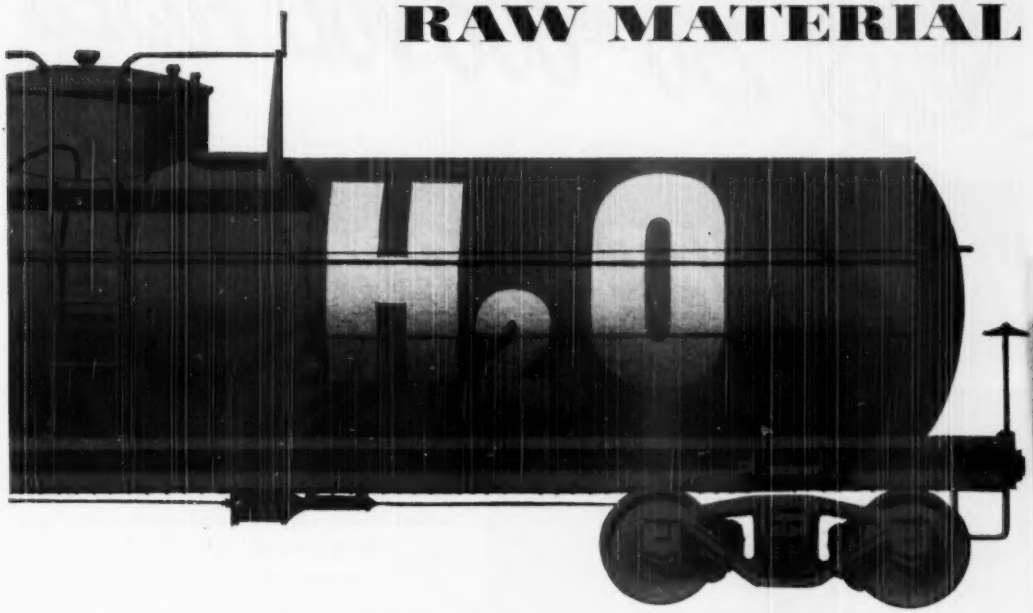
BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • ESTABLISHED 1865

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

(Advertisement)

YOUR MOST IMPORTANT RAW MATERIAL



In many industrial plants, water is, literally, the most important raw material. It is used at virtually every stage of manufacture and the total volume required exceeds that of any other material.

Industrial water, important in terms of volume, is even more important because it is expensive—not in dollars per million gallons but in dollars per unscheduled outage of a boiler, dollars per cleaning of a heat exchanger, dollars per day's production of textiles sent back for re-dyeing.

To reduce the high cost of these "hidden taxes" imposed on the use of water for boiler feed, for cooling or for process use requires more than legislative debate or executive order—it requires the objective collection and interpretation of facts, frequently beyond the apparent limits of the immediate problem.

Through long experience with water problems of all kinds, in industrial plants of all types, Hall Laboratories is equipped to deal with your water problems on a *plant-wide* basis, from selection of source to waste recovery and disposal. Hall engineers recommend detailed procedures which represent not only the best solution to the individual problem but also the greatest contribution to over-all efficiency and economy in your use of water.

If you are concerned with any industrial use of water, you will be interested in the new Hall Bulletin "Your Most Important Raw Material." May we send you a copy?

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pennsylvania.

HALL *plant-wide* WATER SERVICE

BOILER WATER CONDITIONING

PROCUREMENT, TREATMENT, USAGE AND DISPOSAL OF INDUSTRIAL WATER

NEW! NEW! NEW! NEW! NEW!

250 AND 600 VOLT FUSES

INTERRUPT 100,000 AMP!

Type EJ-6 fuse rated 250 volts a-c, 30 amperes (actual size)

...AND THEY'RE LISTED BY UNDERWRITERS' LABORATORIES

These new General Electric Type EJ-6 current-limiting power fuses are for application on 600-volt a-c (and below) circuits where the short-circuit current may reach 100,000 amperes. You get increased protection when you use EJ-6 fuses.

RATINGS Standard NECS size fuses are available in 30, 60, 100 and 200 ampere sizes in both 250- and 600-volt ratings. All ferrules and blades have silver surfaces to reduce contact losses. Fuses will interrupt 100,000 rms amperes total asymmetrical current including the d-c component of fault current.

FUSE CLIPS The new EJ-6 fuses are designed to fit standard NECS fuse clips. Also available are special-design clips that prevent the insertion of other NECS fuses. Short-circuit stresses cannot jar fuses loose from these clips. Protect your equipment and personnel by allowing only fuses of high interrupting capacity to guard your circuits.

For additional information on these new fuses ask your G-E Sales Representative for a copy of publication GET-1819 or use the handy coupon. *Apparatus Dept.; General Electric Co.; Schenectady 5, New York.*

Section K-856-30
Apparatus Department
General Electric Company
Schenectady 5, New York

Please send me your bulletin, GET-1819, that describes the new Type EJ-6 Current-limiting Power Fuse.

Bulletin needed for: .....Reference purposes .....Planning immediate project

NAME.....
(Please Print)

POSITION.....

COMPANY.....

CITY.....ZONE.....STATE.....

GENERAL ELECTRIC

It's no time to fiddle!

HEADLINES warn us of the menace of spies and subversive agents. But in every community there is a hazard, largely unrecognized, which may become ready tinder for the ravaging flames of socialism and communism. This is the misconception of everyday economic facts that exist among our young people.

For example, a recent poll among high school seniors shows that the majority of them believe that the owners of business take out for themselves a larger share of the income than is paid to employees. They think the stockholders' average return is 24% of the sales dollar. The truth is that stockholders average less than 3%, whereas over 30% of the income dollar is paid out as wages, pensions and other benefits.

Our young people do not seem to realize that paying dividends is only one function of profits. Far more important today is the need for profit to keep business competitive, and to pay for new buildings, machinery, and other necessary equipment and to provide new and more jobs. Ignorance of this fundamental concept breeds contempt for the system of enterprise that built our country and keeps it strong.

The facts of business must be given to our boys and girls to protect their future. Only business men can supply the facts. As a business leader in your community, it is your responsibility to help clear up such misconceptions. The old story that Nero fiddled while Rome burned must not have a counterpart in America.

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

RAILROAD TRACK SPIKES - CONDUIT - HOT AND COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RODS - SHEETS - PLATES.

29 Coal Mines and Power Plants Report...

1. A total of 61,161,372 tons crushed.
2. Average age of American Crushers at time of survey — 9.35 years.
3. Average parts replacement cost $.0012 per ton (includes cost of standby parts not yet needed).

CONCLUSION:

AMERICANS CAN "TAKE IT"! NEEDING NEW PARTS *LESS OFTEN*, THEY KEEP OVERALL PRODUCTION EFFICIENCY *HIGH*.

HERE ARE A FEW CASE HISTORIES

A COAL MINE IN ILLINOIS reports 4,000,000 tons crushed over 10-year period by their American AC3-E Crusher — with a parts replacement cost of $.0005 per ton.

AN INDUSTRIAL POWER PLANT IN WEST VIRGINIA has an American 38-S Crusher that has reduced 10,008,000 tons over last ten years. Parts replacement cost was only $.0008 per ton.

A CENTRAL STATION IN NEW JERSEY crushed 6,000,000 tons over a 20-year period with their American 42-S. Parts replacement cost was only $.00025 per ton. Crusher still going strong.

CRUSH COAL AT A TOTAL COST OF LESS THAN 1¢ PER TON

ORIGINAL COST of an American Crusher . . . plus MAINTENANCE . . . plus POWER . . . plus INTEREST ON INVESTMENT averages less than 1¢ per ton crushed. The American Pulverizer Company has many case studies to prove this fact.

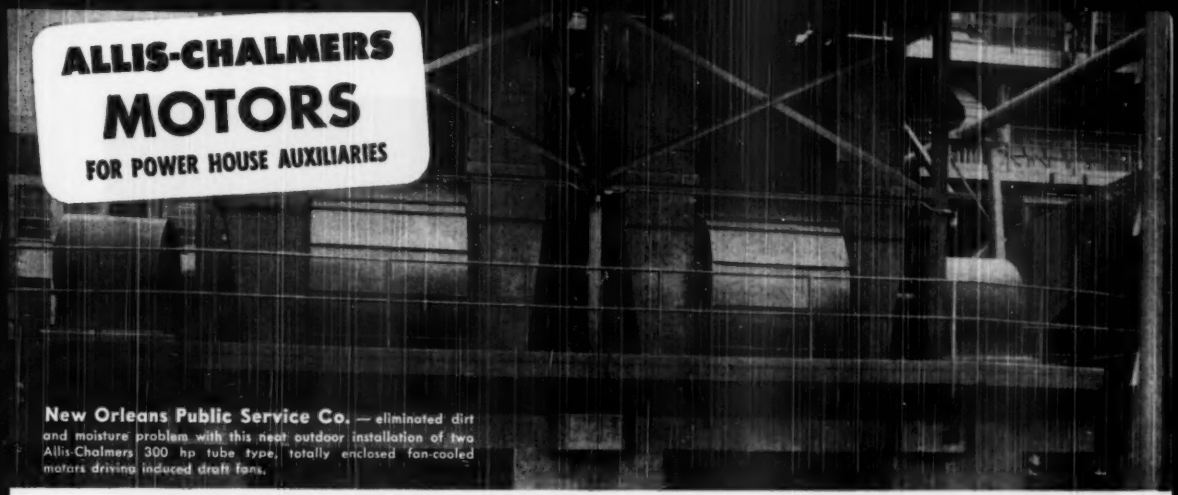
Let an American Representative analyze your crushing problem.
Write for details on the complete line of American Crushers.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

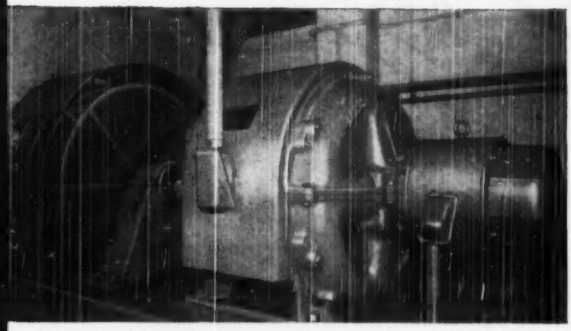
1349 MACKLIND AVE.
ST. LOUIS 10, MO.

ALLIS-CHALMERS
MOTORS
FOR POWER HOUSE AUXILIARIES



New Orleans Public Service Co. — eliminated dirt and moisture problem with this neat outdoor installation of two Allis-Chalmers 300 hp tube type, totally enclosed fan-cooled motors driving induced draft fans.

Motor Reliability For Toughest Jobs!



Potomac Electric Power Co. — drives induced draft fan through an electric coupling with this 400 hp drip-proof Allis-Chalmers motor.

HERE ARE REASONS why utilities like these all over the country are using Allis-Chalmers motors for their auxiliary drives.

First, motors are furnished in every needed type and size. In addition, each motor has features to assure the reliability that power plants need. For example: two pole motors have a pressure vent arrangement in the bearings to prevent oil leakage into the stator in spite of the high speed of the motor.

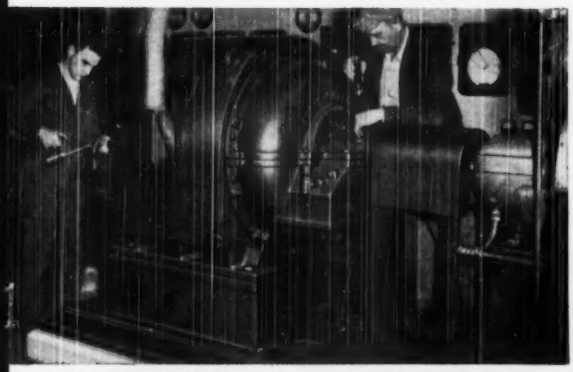
The tube type, totally enclosed fan-cooled motor has straight heat exchange tubes which are self cleaning under practically all conditions and make the motor ideal for outdoor locations.

Extra varnish treatment is provided in all power house motors to resist moisture and acids — assure long life.

Allis-Chalmers is equipped to build the complete motor-pump-control package. If you intend to modernize or enlarge your facilities, it will pay you to specify Allis-Chalmers. Call your nearby A-C Sales Office for further information.

A-3084

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.



Kentucky Utilities Co. — uses two of these highly reliable Allis-Chalmers 700 hp two pole motors to drive high pressure boiler feed pumps.

Toledo Edison Co. — drives condenser pumps with these two 400 hp vertical cage motors.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Confused..

ABOUT THE PROPER FEEDWATER TREATMENT METHOD?

Hot Process? Cold Process? Ion Exchange?

ALL three (and combinations thereof) have advantages for the types of waters and heat exchange equipment used. None is universal in its application. Confused? Don't be—INFILCO can help you and your engineers select the right treatment method *and supply the correct treatment equipment* to convert your water supply to the quality of feedwater your plant requires. ☆It takes MORE than just chemicals, tanks, and exchange materials . . it takes *experience*—the type of experience INFILCO has gained through half a century of assisting plants like yours in solving their question of "WHAT treatment method?" Ask our Chicago Office or nearest field engineer, for complete information. No cost or obligation is involved. Or write for and return our Water Conditioning Analysis Sheet, promptly.

FREE LABORATORY SERVICE . . SEND FOR THIS WATER CONDITIONING ANALYSIS SHEET!

Make sure your water meets the exacting specifications you require. Send for our Water Analysis Sheet, then fill in and return it with a sample. You will receive our laboratory analysis and report promptly. A valuable INFILCO CHEMICAL CALCULATOR slide rule sent FREE to all who return our analysis sheet properly completed. *No cost or obligation is involved for this laboratory service.*

INFILCO

• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894

INFILCO INC.

GENERAL OFFICES: 325 WEST 25th PLACE, CHICAGO 16, ILLINOIS

SALES OFFICES IN TWENTY SIX PRINCIPAL CITIES

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

POWER

CROSS-INDEX OF SUBJECTS FOR THE MONTH

JULY 1950 • VOL 94 • NO. 7

P W SWAIN *Editor*
L N ROWLEY *Executive Editor*
F A ANNETT *Associate Editor*
J C McCABE *Associate Editor*
B G A SKROTZKI *Associate Editor*
T G HICKS *Assistant Editor*
J J O'CONNOR *Assistant Editor*
C F SANDERS *Assistant Editor*
C F MARSCHALEK *Art Editor*
SHELTON FISHER *Publisher*
W J HARING *Sales Manager*

Washington: GEORGE B BRYANT JR Atlanta: EARLE MAULDIN
WORLD NEWS OFFICES: London, Paris, Frankfurt, Tokyo, Melbourne, Rio de Janeiro, Mexico City

PLANT OPERATING METHODS, MAINTENANCE AND SAFETY
STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

FEATURE ARTICLES

120 radial engines make cheap kilowatt-hours 76
It pays to know your centrifugal boiler-feed pumps 82
How to handle ammonia safely 85
Some gripes about grease 88
Pneumatic ash-handling systems 90
Pulling stubborn keys from machines 94
Inexpensive fluorescent solution spots condenser leaks quickly 96
New controls for tube-film deposit 98
Mechanical vibrations: Angle and amplitude — 2 102
Load needs dictate motor selection 104
Tile pipe helps generator load test 106
Pump veterans retire after 50 years 107
Letters from a turbine specialist — 12 111
How to apply 85% magnesia heat insulation 112
Controlling steam-station efficiency: 1 116
Temporary generator tailored to fit 119
Census data reveal U.S. power pattern 120
Instruments put know-how into chemical recovery unit's operation 122

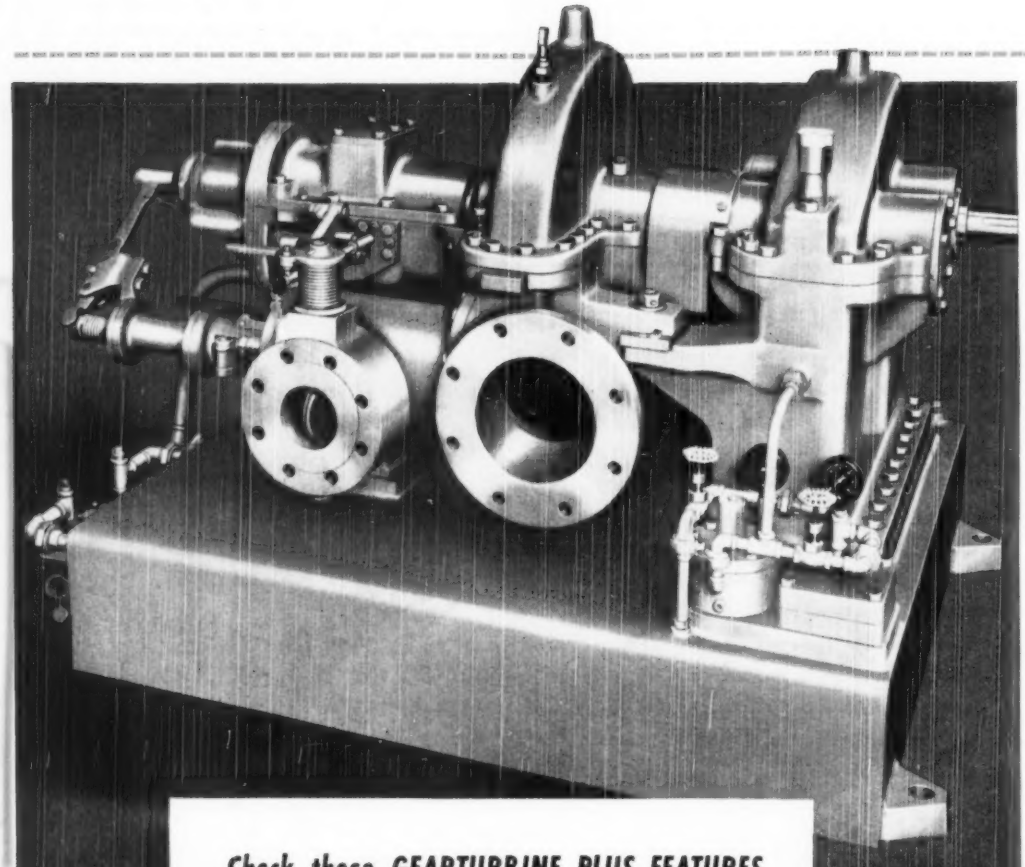
DEPARTMENTS

Electronics: Smoke-density indicators — Part 3 126
Power engineer's notebook of plant-tested ideas 130
Problems from the plant 134
Technical briefs 138
Power news 142
Data sheet 146
Plant equipment news 148
George Edwards 154
Reader's service page 196a

VOLUME 94, NUMBER 7 • ABC • ABP • COPYRIGHT 1950 by McGRAW-HILL PUBLISHING CO., INC. • ALL RIGHTS RESERVED
James H McGraw (1860-1948), Founder; Curtis W McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A Gerardi, Vice-President and Treasurer; John J Cooke, Secretary; Paul Montgomery, Senior Vice-President, Publications Division; Nelson Bond, Vice-President and Director of Advertising; J E Blackburn Jr, Vice-President and Director of Circulation • DISTRICT MANAGERS: New York, W W Quarles; Philadelphia, C R Long; Cleveland, N O Wynkoop Jr; Chicago, C Boughton, J L King; Boston, J E Slater; St. Louis, C Boughton • PUBLICATION OFFICE 418 West 25th St, New York 1, N. Y. • EDITORIAL AND EXECUTIVE OFFICE, 330 W 42nd St, New York 18 N Y • Cable Address: "McGraw-Hill New York" • DISTRICT OFFICES: 520 N Michigan Ave., Chicago 11; 8 Post St., San Francisco; National Press Bldg, Washington 4; Architects Bldg, Philadelphia 3; 738-9 Oliver Bldg, Pittsburgh 22; 1510 Hanna Bldg, Cleveland 15; 2980 Penobscot Bldg, Detroit 26; Continental Bldg, St. Louis 8; 1427 Statler Bldg, Boston 16; 1011 Rhodes-Haverty Bldg, Atlanta 3; 1111 Wilshire Bldg, Los Angeles 17; First National Bank Bldg, Dallas 1; Aldwych House, Aldwych London WC2 • POWER articles are indexed in both the Industrial Arts and the Engineering Index • POWER issues its own index annually; copies are available on request to the editorial offices, 330 W 42nd St, New York 18.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



Check these GEARTURBINE PLUS FEATURES

SOLID COUPLING of turbine shaft to pinion shaft. Makes it easy to align pinion bearings with turbine bearing.

SINGLE-HELICAL GEARING. Endwise movement of one shaft will not affect axial location of the other. Running clearances are maintained.

INTERNAL OIL PASSAGES avert accidental damage, improve appearance.

FORCED CIRCULATION OF FILTERED OIL assures thorough lubrication of gears and bearings.

3-POINT SUPPORT for maximum ease in leveling and aligning.

UNIQUE OIL RESERVOIR forms sturdy base for unit—simplifies mounting and installation.

NEW GEARTURBINE

cuts initial costs

These "standardized" drives cost less to buy, less to install and operate. They wrap up—in a single, compact "package"—a rugged speed-reduction unit solidly coupled to a Type E turbine. Initial cost is substantially less than turbines with separate speed reducers.

It's a winning combination that brings the efficiency of high-speed, single-stage turbines to slower speed equipment such as fans, pumps, compressors and generators . . . at substantial savings.

Standardization results in savings in manufacturing costs, avoids costly specials, saves space, assures perfect factory alignment of turbine and reduction gearing. Yet, you get maximum flexibility. Any combination of three turbine wheel sizes, three gears and three types of governor can be used, according to your needs. Many turbine parts are interchangeable between wheel sizes. Liberal use of corrosion-resistant materials insures long, trouble-free operation. Maintenance is almost negligible.

Westinghouse Gearturbines are especially applicable for ratings up to 500 hp and output speeds commonly found in single-ended applications.

For your steam drives that require speed reduction, get these cost-saving benefits. Call your nearby Westinghouse representative for data and application help, or write for Booklet B-4346. Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa. J-50507

SEE THE NEW TYPE E TURBINE MOVIE

Ask your Westinghouse representative for a showing *in your office*. Takes only 10 minutes.

Westinghouse
TYPE E
Gearturbines

This tank, just being lifted from the galvanizing bath, is one of three ordered by the New York Board of Water Supply for installation in a sewerage project at Grahamsville. The tanks were specified "Wrought Iron." One tank, 36-in. in diameter, will be used for oil, and two, 42-in. in diameter, for water. The general contractor on the project is Di Marco and Ciccone, Inc.; tanks were fabricated from Byers Wrought Iron plates, and galvanized by L. O. Koven and Brother, Inc.

When the design calls for galvanizing, wrought iron offers a definite advantage, for the naturally rougher surface of the material takes and retains a heavier coating. Of even greater importance is the fact that corrosion resistance is not confined to this surface coating, but is inherent in the wrought iron itself. A break in the galvanizing does not mean the *end* of protection, but the real *beginning!*

Some of the most dramatic examples of wrought iron's unusual durability are provided by old water towers and tanks. One such was a water tank erected by a Western railroad in 1881. Although exposed to salt air from the bay, only 200-feet distant, it continued in service for over 62 years, before it was dismantled.

Wrought iron resists corrosion in tank service because of its unique composition. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and disperse corrosive attack, and thus discourage pitting. The fibers also anchor the initial protective scale, that shields the underlying metal.

If you have any tanks that are exposed to internal corrosion from their contents, or from soil or atmosphere externally, you will find it profitable to investigate the service possibilities of Byers Wrought Iron. Write us, or ask the nearest division office for information on WROUGHT IRON FOR TANK CONSTRUCTION.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, San Francisco. Export Division: New York, N. Y.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

POWER

PHILIP W SWAIN, EDITOR • JULY 1950 • ESTABLISHED IN 1882

Enough Power?

WE'RE IN THE MIDST of the biggest wave of power construction in our history. It's putting some fat on a national power system that pulled us through World War II without faltering but came out of it bone-thin. The big question now seems to be, "Have we got enough fat if another war comes?"

Chairman of the National Security Resources Board, W Stuart Symington, takes a somewhat pessimistic view. Transmitting NSRB's *Third National Electric Power Survey* to the President, he pointed out that expansion now under way will provide a total capability of more than 76 million kw in 1952, an increase of 40% over 1948. Yet he said, "This capacity does not assure security from the standpoint of power policy. If war were to break out, power would still be one of our crucial problems."

Many industry authorities are more optimistic. NSRB's recent report is based on a survey made last October. The Edison Electric Institute's semi-annual survey, released late in May, contains new estimates of construction, not available last October. It thus presents a brighter picture. EEI finds that reserves of generating capacity will total more than 18% next year and will stay that high, or go higher, through 1953. They assume average water conditions for hydroelectric operations.

Figures differ, of course, from region to region. But by 1951 all areas should show reserves of 15% or better except two—the Southeast (FPC Region III) and Pacific Northwest (FPC Region VII). Region III, including TVA, will wind up this year with only 8.2%, climbing to 12% in 1953. Things are really tight in VII's western section, but overall reserve should reach 12% in 1953.

Adverse hydro conditions will pull these figures down, of course. If weather frowns, reserves for the nation will run 13% this year and 16.3% in 1952. Region III's margins would drop to 2.8% this year and 7.9% in 1953. Lack of water would cause deficits from 7.7% this year to 1.4% in 1953 in Region VII's western section. These would be offset by only slight margins in the eastern portion.

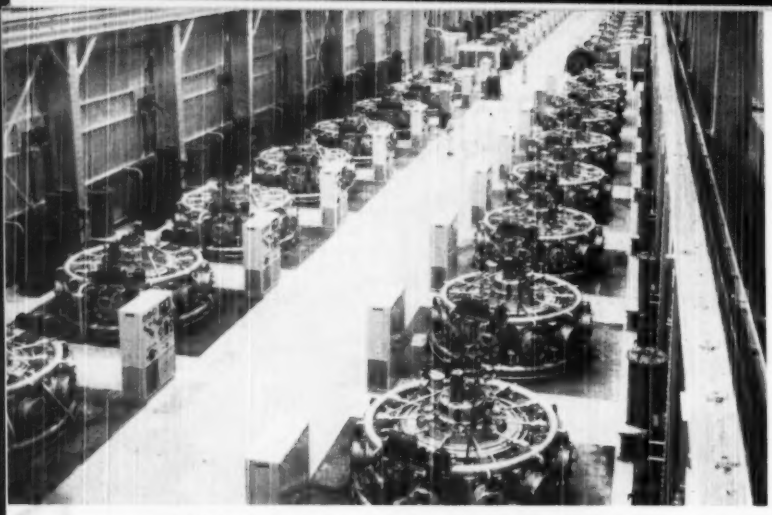
Most encouraging part of EEI's survey deals with manufacturing capacity. Builders of heavy power equipment have bitten deep into backlogs, largely overcome shortages of materials and labor. Best estimates put total manufacturing capacity at 10 million kw per year—8 for steam, 2 for hydro.

Thus delivery schedules run better: 20-24 month for large turbine generators, 8-12 mo for small. Current deliveries for boilers range from 6 to 14 mo. For hydro units the span is from about 9 mo for small ones to 24 mo for the largest. Most builders have open capacity from 1951 on, some now.

Are these reserves and capacities enough at a time when we must consider war as a possibility? Certainly greater margins would make us all more comfortable. Yet need for efficient peacetime operations puts a definite check on expansion.

We can weigh these factors better if we remember what happened in World War II. We saw then how the entire economy shifted to a war basis. Need for full use of limited manpower and materials put an automatic check on "normal" industry and civilian activities, cut "non-war" power demand as effectively as any planned rationing. This, plus around-the-clock industrial operation, "war time," pooling, and slimmer reserve margins, carried us with vastly less than indicated capacity increase.

Thus, while predicted future reserves leave no room for complacence and certainly none for any slackening of construction, it does seem that the present program gives no real cause for alarm.



1 **RADIAL GAS ENGINES** as you see them from crane platform of one engine house. Each such building serves one pot line, houses 40 engines driving 1150-kw generators operating at 1000 kw. For three lines, total is 120 units, 120,000 kw

POWER *takes you to—World's largest* **GAS-ENGINE PLANT**

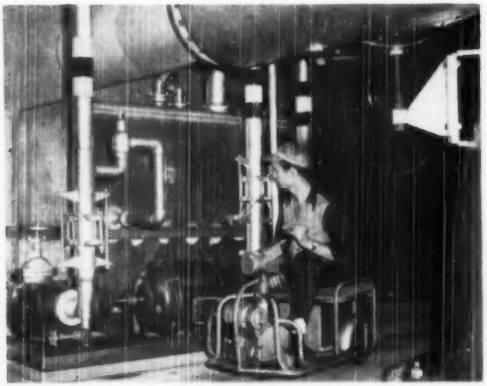
Here's what you'd see on your first quick look around one of the three powerhouses. Each of them contains 40 Nordberg radial spark-ignition engines, giving this radically different plant a total of 198,000 hp. For answers to the questions on engine construction and plant layout that would pop up as you made such a tour, turn to the two spreads following this one.

At Alcoa's New Point Comfort Works...

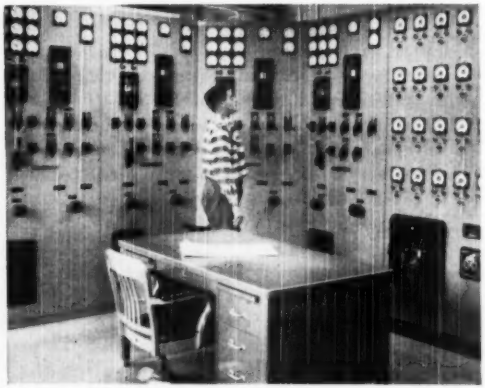
120 Radial Engines Make Cheap Kwhr

. . . from Texas natural gas. Why this swing to fuel-produced power? Why gas engines instead of a steam plant? Why this unconventional new engine design? Here are some answers:

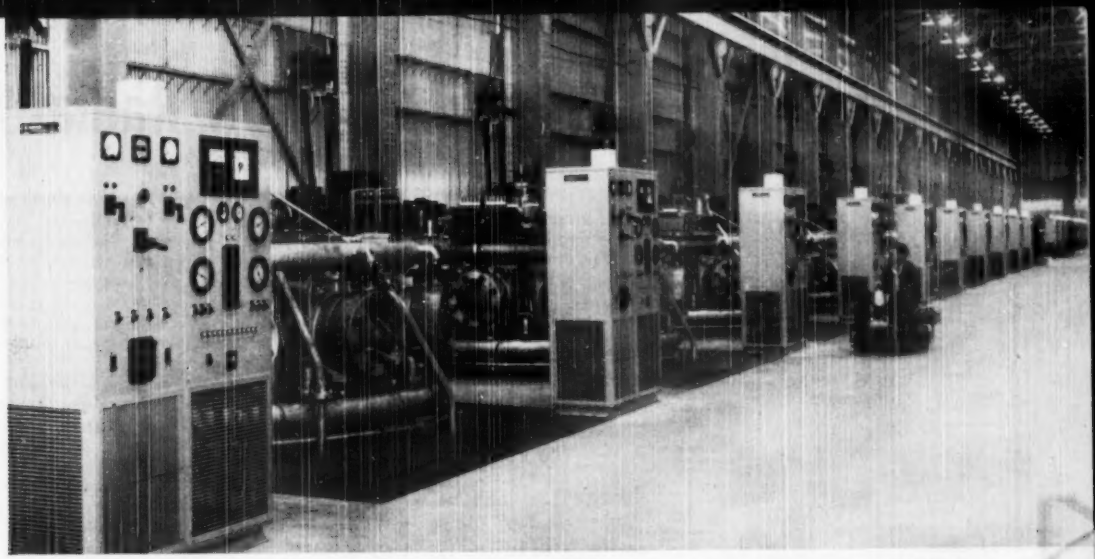
- **Low-cost power is vital to aluminum production. In the past, hydro did the job. Now, with good sites harder to find, trick is to go to cheap fuel**
- **Today's higher compression gas engines compare favorably on efficiency, have edge over steam turbines because they generate dc directly, need no expensive conversion equipment**
- **Radial design developed particularly for this service offers compactness, simplicity, easy maintenance needed for large multiple-engine plants**



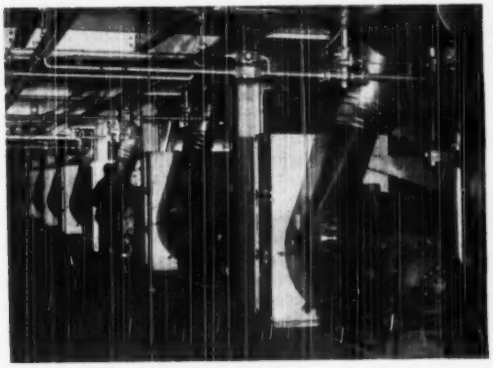
5 **LUBRICATING-OIL EQUIPMENT** can be seen on other side of engine base. Lube-oil tank is at rear. In front of it are lube-oil and jacket-water pumps, common motor



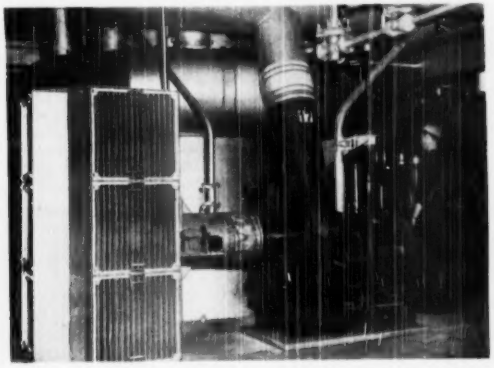
6 **MASTER CONTROL ROOM** for pair of powerhouses stands between them. Here you see recording and indicating devices for generators, auxiliary power and motor-generator units



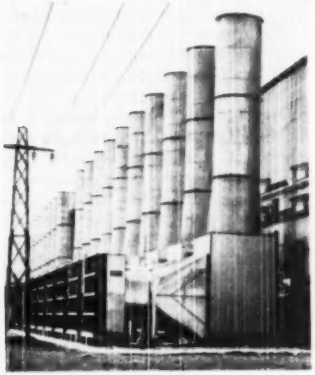
2 **ON OPERATING FLOOR** you get a closer look at the unusual construction of these compact spark-ignition engines, and complete setup of automatic controls and alarms for them. Each building's central aisle is approximately 500 ft long, so you find attendant making his inspection rounds quickly and conveniently on rubber-tired battery-powered scooter



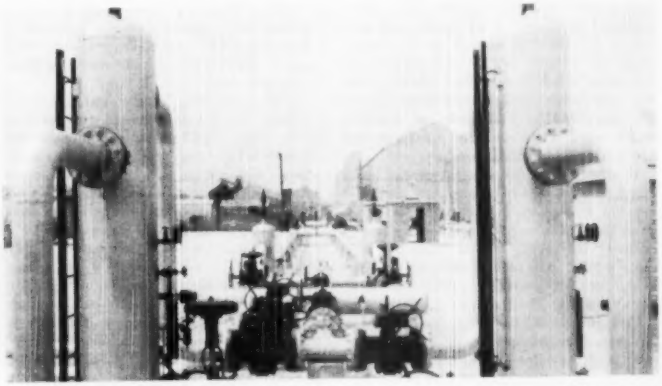
3 **IN BASEMENT** you see orderly rows of engine auxiliaries, realize that each engine-generator and associated units is an entirely independent power plant. They tie only at bus



4 **SCAVENGING BLOWER** takes in washed air from the basement, through dry-type filter. Behind blower you can see steel engine base, which houses a vertically mounted generator

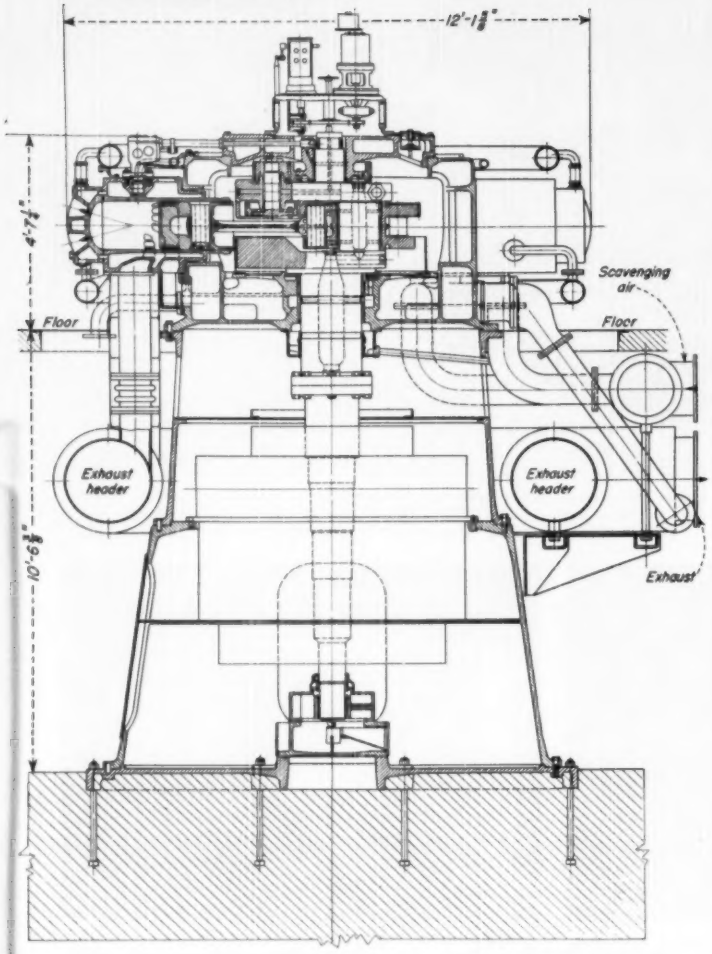


7 **STEPPING OUTSIDE** you see long row of stacks, one to an engine. In front of them are radiators for water, oil



8 **AT GAS PRESSURE-REDUCING STATION** you look back toward an engine house over the cocks and reducers through which fuel gas from nearby fields comes to the plant. Small brick building houses pressure-measuring and flow-metering units

For radial-engine features turn page ➤



HERE ARE DESIGN FEATURES OF ENGINE-GENERATOR SETS

Compact arrangement of engine and generator is shown in section above. Crankshaft is vertical, with crank above and generator below in cool zone. Eleven cylinders bolt radially to symmetrical main-frame casting. This, in turn, bolts to 3-section welded-steel base, which also supports scavenging and exhaust headers.

Central hub in main frame carries lower crankshaft main-bearing bushing and thrust bearing, which supports load of crankshaft, generator shaft, rotor. Heavy cover, also of symmetrical design, bolts to frame top, contains upper crankshaft bearing bushing. Lower end of generator shaft rides in a steady bearing.

Pistons consist of two aluminum-alloy forgings. Ring-carrier section, with piston-cooling-oil passages, is shrunk over upper part of main section, and welded at the top. Wristpins are full floating. One-piece drop-forged connecting rods carry knuckle pins clamped in crankend. (For details of connecting-rod assembly and how it works to eliminate master connecting rod, see facing page.) All bearings are one-piece bushings —no split shells.

When arranged for gas burning, each cylinder has a cage-mounted gas valve to admit fuel. Rocker arms and pushrods actuate these valves from a cam on crankshaft. Gas enters in path of incoming scavenging air for thorough mixing. Governor-actuated valve in gas line varies pressure to adjust amount of gas delivered.

Mechanical force-feed lubricators supply cylinder oil. Continuous-pressure system lubricates bearings, gears, other moving parts. Lube oil enters crankshaft through lower main bearing; passages distribute it throughout engine. Piston-cooling oil enters and leave pistons through rifle-drilled holes in connecting rods. It returns to lower part of crankcase. With returned lube oil, it drains to sump tank to be strained, cooled, recirculated.

How Radial

► To make one pound of aluminum takes 10 kwhr of dc electricity. Thus economical production depends on low-cost power. Although Alcoa's first plant, built 62 years ago, used gas as fuel, hydro power has done the job in plants built since. But securing good commercially-available hydro sites has become increasingly tough.

Back to Gas. The swing back to fuel-produced power really began during World War II, when Alcoa engineers designed a reduction plant in Arkansas for DPC. Part of needed power came in by transmission line, part was to have been supplied by a gas-fired steam plant. When turbines couldn't be had, designers turned to gas engines, abandoned the steam plant. The gas engines drive dc generators directly, eliminating expensive conversion equipment.

Experience with this plant (Power, Nov 1944, pp 720-25) convinced Alcoa engineers that the gas engine is a valid answer and that plants with large numbers of these engines can be made entirely practical. But they believed units better suited to such service could be developed. Nordberg engineers thought so, too. Out of their collaboration came these unconventional engine-generator sets.

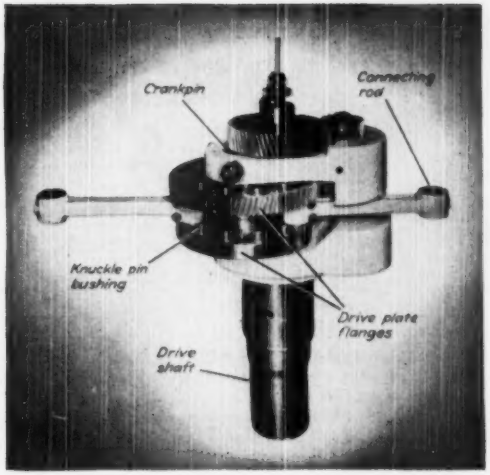
Engine Features. Forgetting details for a moment, radial design, with generator mounted vertically underneath, yields these advantages: (1) Unit is compact, light in weight. (2) Design permits full counterweighting, virtually eliminates vibration. This allows simple, inexpensive foundation. (3) Installation is easy. Engine can be shipped fully assembled. Once bedplate is leveled on foundation pad, no further alignment is needed—base, generator stator, engine bolt together with machined joints.

Maintenance is simplified because there are no split bearings, only renewable bushings; all heads, pistons and cylinders are fully interchangeable.

Gas Burning. Engines are built for oil-diesel, dual-fuel or spark-ignited gas operation. For Point Comfort, Alcoa engineers chose the latter. Low cost of gas fuel didn't justify greater investment for slightly higher efficiency. With gas fuel, units operate at about 260-psig compression and 650-psig firing pressure. Gas comes to the engines, under governor control, at about 6 psig, after several reductions. Scavenging-air volume is also regulated in proportion to load by throttling blower suction.

Ignition System. To keep attention and maintenance to a minimum, and reduce rate of spark-plug electrode

Design Saves Space, Reduces Vibration



HOW GEAR ASSEMBLY ELIMINATES MASTER CONNECTING ROD USUAL IN RADIAL ENGINES

Developed by Nordberg designers, this unusual method of transforming connecting-rod motion to crankshaft rotation yields a number of advantages: (1) It eliminates the master connecting rod usual in radial engines. All rods are identical. (2) It makes possible full counterweighting, with a great reduction in vibration. To see how mechanism works, look at pictures above.

The crankshaft is built in two sections. Lower one comprises crankpin, counterweight, and short drive shaft. Polished underface of counterweight rides on eight tilting pads of the thrust bearing. Upper crankshaft section includes the upper counterweight and the shaft journal. After master gear and drive plate are in position on the crankpin, upper section dowels and clamps to the lower.

Upper counterweight carries two pinions. One is below and meshes with the master gear. The other is above on the same shaft. It meshes with a stationary gear fastened to the cover. Connecting-rod knuckle pins are bushed in the master gear assembly.

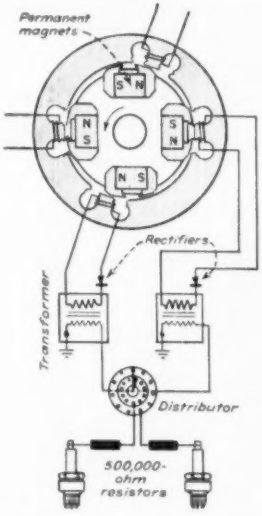
Cylinders fire in order, in clockwise rotation. Master gear cannot rotate because it is tied to stationary gear through the two pinions. Con-rod motion causes it to swing around in a circular path. This gyration makes the upper pinion "walk" around the stationary gear and the lower pinion "walk" around the master gear.

erosion, a newly developed ignition system employs an impulse generator. It has no cams, breaker points, brushes, collector rings or rotor windings. Its output, at the plugs, consists of accurately timed unidirectional impulses similar to half a familiar ac wave.

Impulse-generator rotor has four elements, each a permanent-magnet assembly, magnetically distinct from other elements and equally spaced. Laminated stator has four windings.

Generator runs at 2.75 times engine speed, so its rotor makes ¼ revolution for each 1/11 revolution of engine. Stator coils are displaced in pairs by 20 deg. This provides a firing differential of about 7.25 engine deg between two plugs in each cylinder. Lower plug fires at 15 deg BTDC and upper at about 8 deg BTDC.

Transformer differs from ordinary spark coil: iron circuit is complete as in conventional transformers. Maximum peak voltage on these units is 25 kv. At



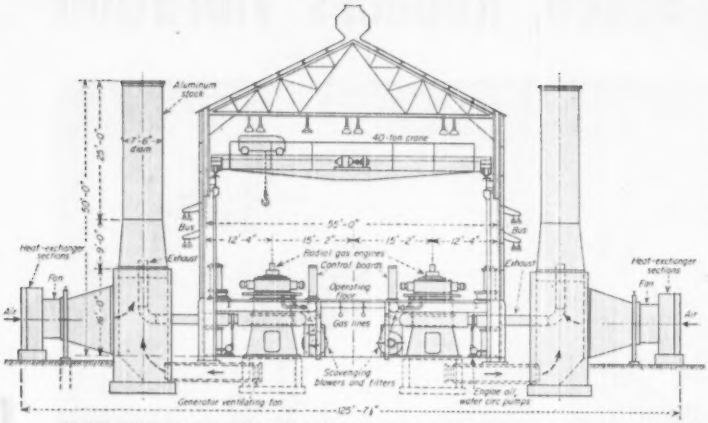
IGNITION SYSTEM'S impulse generator has a 4-element permanent-magnet rotor

each plug a 500,000-ohm resistor, in series, helps avoid harmful effects and rapid plug erosion normally resulting from capacity energy stored in long high-tension leads.

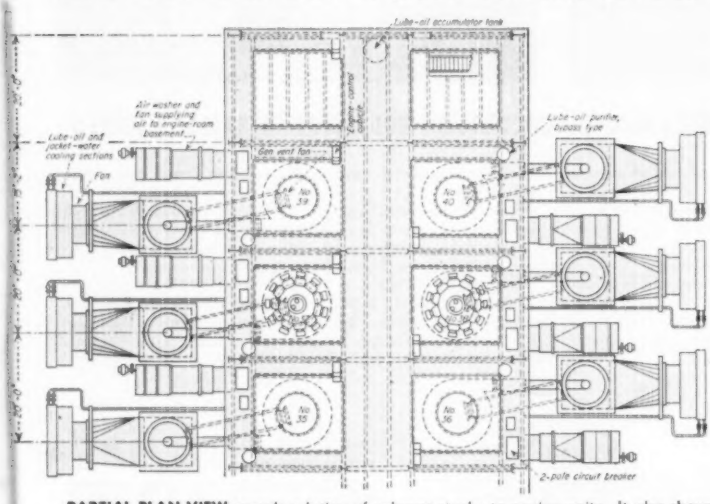
Use of selenium rectifiers in circuit eliminates small positive impulses and gives single unidirectional impulse. This also helps keep electrode erosion down. Polarity of various parts is arranged to make center electrode negative. This concentrates erosion on multiple and cool grounded electrode.

Performance. At 400 rpm, engines are rated at 1800 hp. With scavenging blower and auxiliaries supplied from generator, net output is 1150 kw. At Point Comfort, engines run at 360 rpm, making net output 1000 kw. Operating on natural gas with 1003 Btu higher heating value and 910 Btu net value, these engines show a fuel consumption of 11.4 cu ft per gross kwhr or 12.42 per net kwhr. This equals 7970 Btu per net bhphr, or 29.30% efficiency.

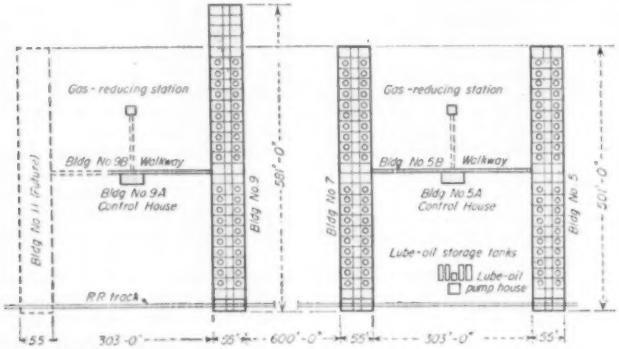
For plant-layout highlights, turn page



CROSS SECTION OF ENGINE HOUSE shows how stacks serve triple purpose. In addition to receiving exhaust, radiator and generator fans discharge into the base


Lube-oil accumulator tank
Air washer and fan supplying air to engine-room basement
Lube-oil and jacket-water cooling sections
Fan
Gen vent fan
Lube-oil purifier, bowls type
2-pole circuit breaker

PARTIAL PLAN VIEW reveals relation of exhaust stacks to engine units. It also shows location of washer units supplying clean, cool air to engine-room basement



ENGINE-BUILDING ARRANGEMENT with control houses between can be seen in plot plan, above. Extension on Building No. 9 provides space for engine maintenance

Plant Layout

► DRAWING ON EXPERIENCE with the Arkansas plant, Alcoa engineers built reliability into Point Comfort, along with surprising ease of operation and maintenance. Nature of pot-line operation helped some. Load does not vary much, nor is line particularly sensitive to small variations.

Balancing such considerations against cost of reserve capacity led to setting unit size at 1000 kw. Out of 40 units in each powerhouse, about 35 normally feed the line, leaving five for standby and scheduled outage. Each set has its own protective gear for automatic shutdown in event of failure—see facing page. Each pair of powerhouses has a central control room in which recording and indicating equipment registers operation of each unit.

Units Independent. Layout provides each unit with its own full complement of auxiliaries—scavenging blower, radiators, fans, pumps, etc,—all driven by ac motors powered from sliprings tied to dc generator winding. Taking field current from an excitation bus, generators are motored for engine starting. Once generator is on line, unit and its auxiliaries form a completely independent power plant.

Alcoa engineers considered engine-heat recovery but multiplicity of units made scheme unattractive. Gas-fired steam generators are installed in a separate building.

Designers also weighed use of bay water for engine cooling, but this would have meant a common system, with indicated corrosion and silting problems.

Cooling, Air Intake. In a novel arrangement, radiator fans draw air past tube sections and discharge into stack base (diagrams, left). Generator fan also discharges there. Exhaust is piped into stack to give slight aspirating effect. The 7.5-ft-dia 50-ft-high aluminum stack discharges exhaust and heated air above roof level.

Forty air washers and fans supply cleaned and slightly cooled air to each powerhouse basement. Scavenging blowers take suction from basement, through filters. Generator-air fans take suction directly.

Independence and uniformity of all power units greatly simplify operation and maintenance. Engine design also contributes—see spread ahead. Full maintenance-shop facilities have been provided in extension of one engine house. To speed assembling and dismantling, most pipe connections are made with Dresser couplings.

Operation. Best testimony to job done in plant layout is that only three men per shift operate each powerhouse—one supervisor and two attendants. They make regular rounds by battery-powered scooter, but log instrument readings only once per shift. With naturally steady load, readings don't change if all goes well—if something goes wrong, controls shut unit down.

It is yet too early to know maintenance schedules. As fast as they can, operators are "breaking step" so operating hours on engines will be staggered. Then maintenance operations will be rotated.

Simplifies Operation and Maintenance

ENGINE CONTROL AND ALARM PANELS

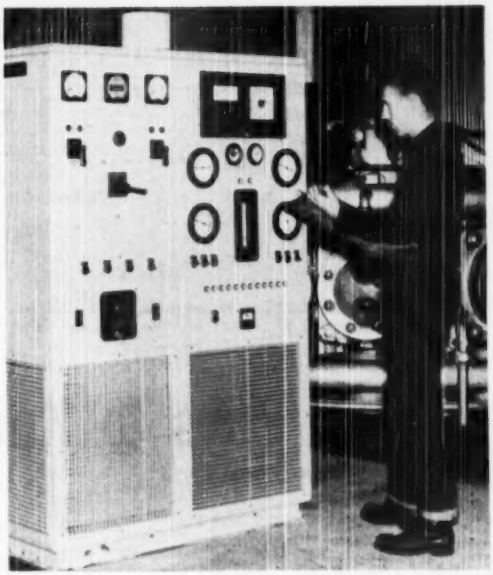
The trick to operating a 120-engine plant lies in making the job as nearly automatic as possible. At Point Comfort, each engine has its own control panel. Once on the line, units operate at steady load for months, until scheduled for outage. If anything goes wrong during that time, automatic protective equipment cuts the unit off, shuts down the engine, and notifies attendants so another unit can be started to replace it.

Left-hand side of board carries dc ammeter and voltmeter at top, with vibrating-reed tachometer between. Handles below are for generator circuit breaker (positive and negative) and, center, for throttle control (generator shunt-field rheostat).

Right-hand side might be called protective panel. At top appears scale and selector switch of exhaust pyrometer. Thermocouple transfer switch is motor driven. Relay connected parallel with indicating pyrometer has a preset pointer, which makes contact when any cylinder's temperature reaches a predetermined point. This, in turn, trips engine off line.

Indicating devices in center include: oil and water temperature and pressure (large dials), cylinder temperature, gas pressure (small dials) and manometer for scavenging-air pressure. Pushbuttons are for scavenging blower control. Below long row of annunciator lights are shutdown relay and operating-time meter.

Engine trip relay shuts off gas, cuts ignition, trips generator breaker and lights red light to attract operator's attention. Any one of the following may energize relay: engine overspeed, high exhaust temperature, low oil pressure, high oil or water temperature, excessive generator temperature, failure of thrust bearing, or of 24-cycle ac circuit for engine auxiliaries.



PRINCIPAL POWER-PLANT EQUIPMENT

Point Comfort Works, Aluminum Co of America, Port Lavaca, Texas

ENGINE-GENERATORS:

Gas engines, radial, spark-ignited, 120 ..... Nordberg Mfg Co
2-cycle port-controlled blower-scavenged, 1650 hp net at 400 rpm, operating at 360 rpm. Eleven 14x16-in. cylinders, aluminum-alloy heads, pistons
Ignition system, impulse type ..... American Bosch Corp
Piston rings ..... Sealed Power Corp
Governors, hydraulic ..... Woodward Governor Co
Lubricators, mechanical force-feed, motor-driven ..... Manzel, Inc
Exhaust pyrometers (Alnor) ..... Illinois Testing Laboratories, Inc
Generators ..... Elliott Co, General Electric Co, Westinghouse Electric Corp (Each company supplied 40 generators.)
1150 kw at 667-v dc and 125 kva at 425-v ac, 24 cycles, for driving engine auxiliaries. Mounted vertically below engines
Generator-cooling fans, 12,000 cfm, axial ..... Sturtevant Div

INTAKE, EXHAUST, COOLING SYSTEMS:

Jacket-water and oil coolers, one per engine ..... Trane Co
Combination units with Alclad aluminum alloy (3S) tubing and fins. Fan is 84 in. dia; six adjustable blades; 2-speed 25-hp motor
Lube-oil and jacket-water pumps ..... De Laval Steam Turbine Co
One Imo and one centrifugal pump, driven by common 15-hp motor
Building-air washers, 120 ..... Continental Air Filters, Inc
Each has 30 all-aluminum washer cells; 125-gpm spray water
Building-air fans, axial, 35,000 cfm, one per washer ..... Joy Mfg Co
Scavenging blowers, one per engine ..... Buffalo Forge Co
Centrifugal, rated at 7000 cfm, driven by 100-hp motor
Scavenging-air intake filters ..... American Air Filter Co, Inc

LUBRICATING AND FUEL SYSTEMS:

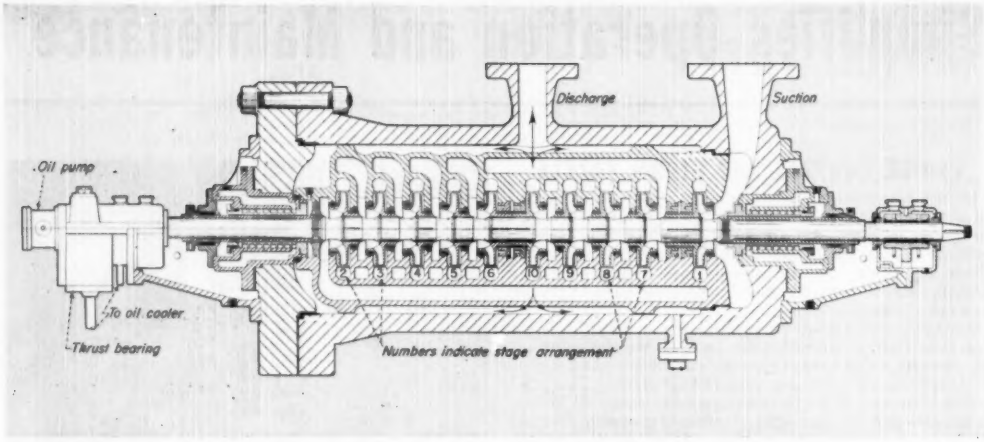
Lubricating-oil purifiers, bypass ..... Hilliard Corp
Lubricating-oil purifiers, batch ..... DeLaval Separator Co
Purifilter type: centrifuge plus Fram filter
Gas-pressure reducers, Gas flowmeters ..... Pittsburgh Equitable Meter Co
Gas-line cocks ..... Nordstrom Valve Div

ELECTRICAL EQUIPMENT:

Generator circuit breakers, 120 ..... I-T-E Circuit Breaker Co
Field-switch, starter cabinets, 120 ..... Cutler-Hammer, Inc
Motor-generator sets, 4 ..... Westinghouse Electric Corp
4000-v ac, for works use, from generators driven by 667-v dc motors. Each set also has 250-v dc generator for crane power.
Electrical instruments ..... General Electric Co, Westinghouse Electric Corp, Weston Elec Inst Corp
Tachometers, vibrating-reed, 120 ..... James G Biddle Co

MISCELLANEOUS EQUIPMENT:

Steam generators, 2 ..... Preferred Utilities Mfg Corp
Gas-fired, package design, 1497 sq ft, 125 psig
Boilers, 2 ..... Preferred Utilities Mfg Corp
Gas-fired, package design, 4180 lb per hr, for evaporating water
Plant air compressors, 3 ..... Ingersoll-Rand Co
Reciprocating, 19½x11½x12 in., 300 rpm
Air-compressor drive motors, 300 hp ..... Electric Machinery Mfg Co
Cranes, one per engine building ..... Northern Engineering Works



1 Horizontal double-case pump for pressures above 1200 psi, temperatures to 800 F. It has a cylindrical outer barrel enclosing a horizontally-split volute casing. The pump discharge pressure is applied between outer and inner casing

It Pays to Know Your Centrifugal

A boiler plant is no more reliable than its feed pumps, so pick them with care. Factors that influence selection are suction conditions, variable-load requirements, material in the casing and internal parts, quality of feedwater, pump design, operating practices

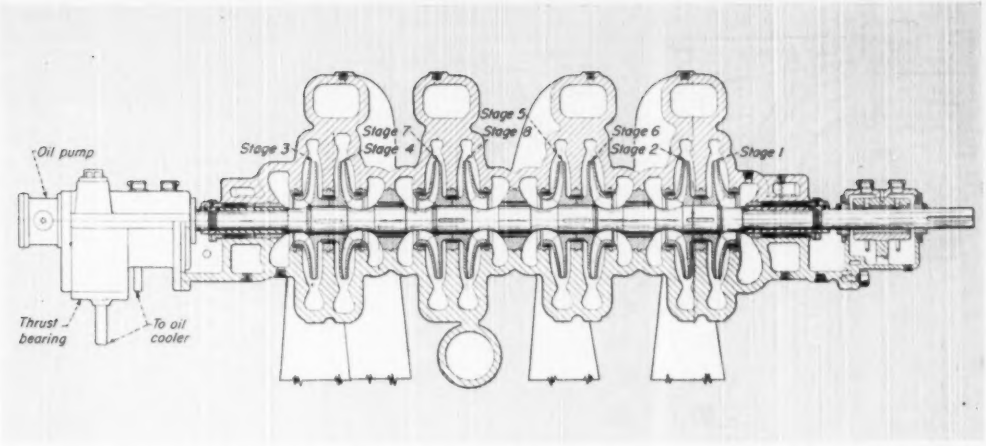
► CENTRIFUGAL BOILER-FEED PUMPS are a vital part of the auxiliary equipment of steam-generating plants. Feedwater must flow into the boilers without interruption. This demand for continuous pump operation makes it necessary to choose the proper feed pump for each specific service. Pump selection varies, depending on required hydraulic performance, feedwater temperature, pump suction conditions, chemical and physical analysis of the feedwater.

Suction Conditions. When selecting a boiler feed pump, suction conditions are the first consideration. Boiler feedwater is usually under pressure in a closed vessel and flashes into steam when the pressure drops below vapor pressure. When this happens, the pump ceases to operate and may be seriously damaged. To avoid this, the net positive suction head (npsh) must be higher at the pump's suction than is usually required for other applications. The higher the feedwater temperature, the higher the pressure should be above the pump's minimum required npsh. Hydraulic Institute gives values to be added to the required npsh for different water-pumping temperatures. Also, pump manufacturers add their safety factor, based on experience with a given boiler-feed pump.

Because of variable-load requirements, the feed pump's performance must be stable from zero to maximum capacity. Two or more pumps usually operate in parallel, to obtain required flexibility for boiler demands when loads change. To have stable performance, pumps must be designed with a constantly rising head-capacity curve from maximum to zero capacity. For best performance, head-capacity rise should not be specified as less than 17%. Sometimes a flatter curve does not ensure stable operation. Or it may force pump manufacturers to place maximum specified capacity to the left of the best efficiency point. This defeats the purpose of saving power over a wide range of pump operation. Pump should be selected for normal operation at best efficiency, and maximum discharge should be slightly to the right of that point. This allows operation at better efficiency at lower loads and saves power under full range of pump performance.

Pump Casing. Material, from which the casing and its internal parts are made, has an important influence on the pump's reliability. About 50% of high-pressure high-speed centrifugal boiler-feed pump failures have been on pumps with low-carbon steel or cast-iron casings. This is because of the erosion-corrosion effect on the material by the feedwater. Few failures have occurred on pumps with 4 to 6% chromium-alloy steels. No failures are known on pump cases made from 11.5 to 13% chromium-alloy steels.

On the basis of the author's nine years' experience with boiler-feed pumps, 11 to 13% chrome-steel casings are best for boiler-feed service. The material does not corrode or erode in feedwater of any chemical treatment and varied pH values commonly used in steam power plants. This metal can also be readily cast, has good welding qualities, and can be hardened up to 500



2 Eight-stage horizontally-split-case boiler-feed pump for pressures below 1200 psi and temperatures up to 300 F. Back-to-back impeller arrangement gives axial balance, while radial balance is obtained by the staggered or double volutes

Boiler-Feed Pumps

By V LOBANOFF, *Assistant Chief Engineer*
United Centrifugal Pumps, Division, United Iron Works

Brinell for internal pump parts. Its slightly higher initial cost pays for itself in the long run where continuous boiler-feed pump operation is essential.

Operating Precautions. Other materials, however, can be successfully used for boiler-feed pump parts. But for best performance take these precautions:

1. Keep pH value of water between 9 and 9½, provided the high pH value is due to the definite alkaline salt addition rather than the presence of transient ammonia.
2. Water conditions that develop red ferric-oxide coating are preferred.
3. Keep total solids below 5 ppm.
4. Avoid use of sodium sulfide.

Even with the proper chemical treatment of feedwater, a low-carbon steel casing runs a 50% chance of failure, especially in pumps operating above 850 psi and 300 F.

Clearances and Fits. In addition to good material in boiler-feed pumps, workmanship and type of design are of prime importance. Clearance and fit tolerances of all parts should be maintained as specified by pump engineers. Avoid high differential-pressure drops within the pump where possible. When they are necessary because of design, pump must be protected by the best material and workmanship. Let the manufacturer specify the clearances between stationary and rotating parts of the pump. His experience with a given boiler-feed pump will give the best field performance with a minimum established clearance. Some users have the misconception that larger clearances prolong pump life.

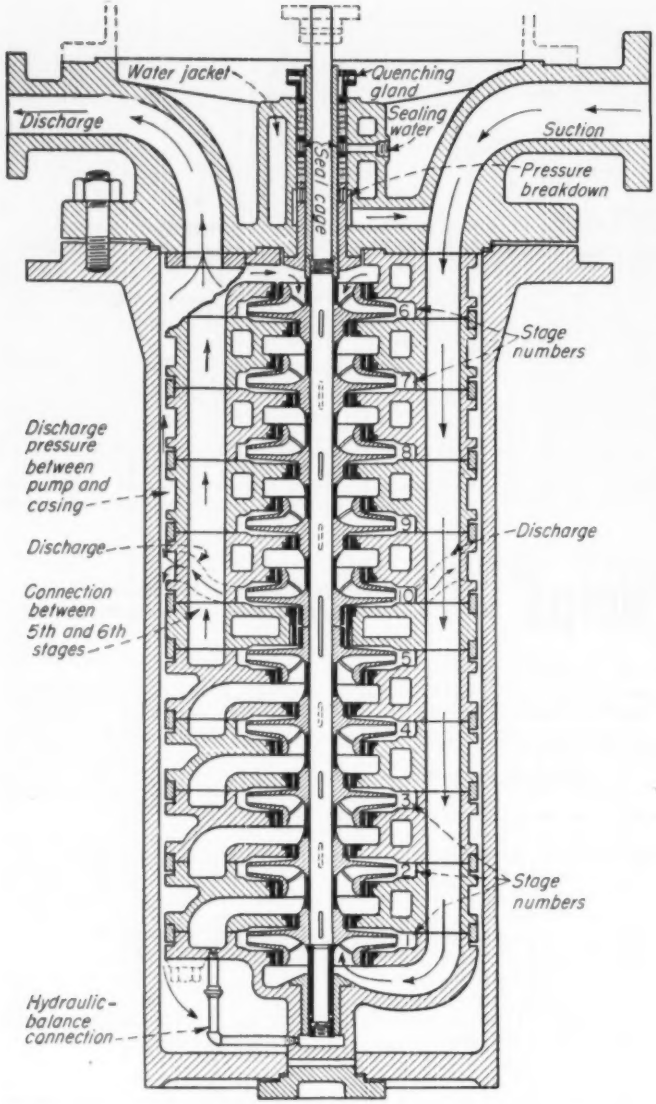
A number of pump users specify clearances that are often larger than those the manufacturer recommends. Large clearance between the rotating and stationary parts may do the pump more damage than good, especially at points of high differential-pressure drop. With normal clearances, leakage loss is kept at a minimum, maintaining efficiency for a long period. With the right clearances, liquid travels a much longer path across the wearing rings without serious wear or wire-drawing of the metal. With larger clearances, liquid flows at high velocity straight across the rings to increase the danger of wire cutting and wear of parts. The larger clearances also reduce efficiency and increase power consumption over the full range of pump performance.

Discharge Closed. A centrifugal pump can operate for only a short time with its discharge valve closed. Work done in the pump under this condition heats the water, and in a short time overheats the unit beyond safe working limits. To prevent this, provide a minimum bypass flow line between the pump's discharge and the suction heater. On small pumps, this bypass can stay open continuously but on larger units it should be automatically opened when the pressure rises to a given value, and closed when pump operation is normal. Size of this bypass varies with each design. Generally a modern high-speed pump can operate successfully with a flow that holds water temperature rise to 35 F. Because of the large pressure drop in the bypass line, install a muffled orifice.

Fit a centrifugal pump with materials of equal temperature expansion and it will maintain proper clearances between its parts, regardless of pumped liquid's temperature. Do not start a cold pump on hot liquid. To prevent the possibility of mechanical damage during starting, provide a warming line on all high-temperature pumps after they have been idle. Thus you can warm them to proper temperature before starting.

Three Pump Types. Several types of high-speed high-efficiency pumps are available. Each unit is specifically designed for a given range of performance. Fig. 1 to 3 show three types of boiler-feed pumps. Fig. 1 is a horizontal double-case unit for pressures above 1200 psi and temperatures up to 800 F. It has a cylindrical outer barrel, enclosing a horizontally-split volute casing. Outer barrel withstands the bursting pressure of the pump, for which purpose it can be readily designed. The inner case is under compression only. It is designed for best hydraulic efficiency and is held tight at the horizontal joint by hydraulic pressure within the outer barrel.

Inner case is a double-volute design



3 Ten-stage vertical double-case boiler-feed pump, for low capacity, high pressures, temperatures, takes small space. Pump has inner casing for each stage

to give the pump a radial hydraulic balance. Axial hydraulic balance is obtained by placing the impellers on the shaft in equal, opposed groups. A Kingsbury thrust bearing takes care of any thrust created by emergency operating conditions. This unit is usually built to individual specifications, and so can adopt any special feature required.

Fig. 2, for pressures below 1200 psi and temperatures up to 300 F, is also axially and radially balanced. Back-to-back impeller arrangement gives axial balance. Radial balance is obtained by staggered volutes or, on the larger sizes, by double volutes. Because of external arrangement of the pump crossovers, efficiency of this type is usually 2 to 3 points better than that of a comparable double-case unit.

A horizontal, split-case, multistage pump can be built with 2 to 8 stages, depending on the required pressure. The casing is horizontally split to dismantle and assemble the pump without disturbing either the driver or the suction and discharge piping.

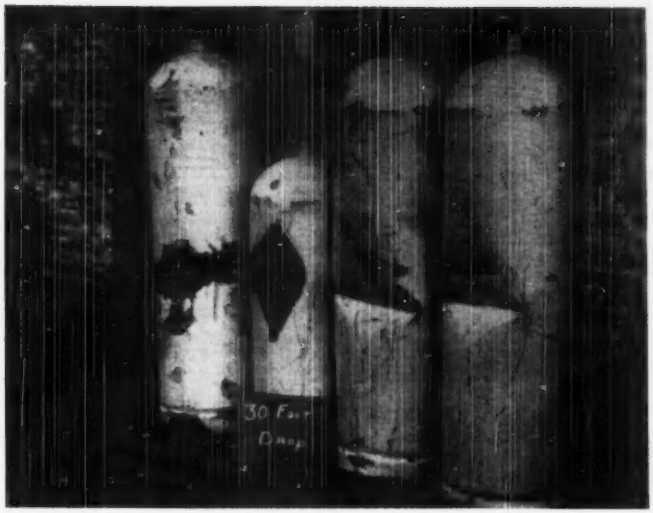
Stuffing boxes in double-case and horizontal split-case multistage pumps are under suction pressure. Even though pumps are hydraulically balanced for boiler-feed service, they have a thrust bearing for added safety.

Vertical-Shaft Pumps. Many users specify horizontal split-case boiler-feed pumps for service requiring low capacities with medium or high pressures. Specification for a horizontal unit is usually given because of the user's previous experience with this type pump. For low capacities, however, a vertical boiler-feed pump design offers advantages over a horizontally split-case unit. Fig. 3 shows construction of a vertical unit, the advantages of which are:

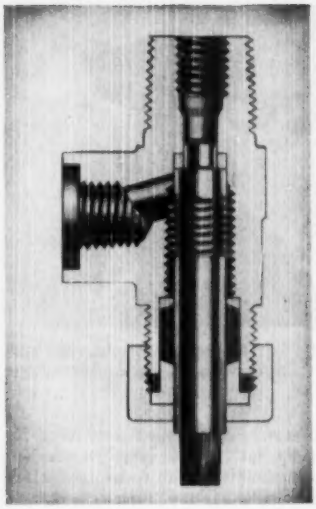
1. Requires minimum floor space.
2. Double-case design has higher factor of safety than horizontally split unit.
3. Has only one stuffing box, which is always under suction pressure.
4. Eliminates shaft deflection because of rotating-element weight.
5. Double-volute design for radial hydraulic balance.
6. First-stage impeller, at bottom of pump, requires lower static head above suction nozzle or, for the same static head, gives the pump a higher factor of safety.
7. Misalignment problems are eliminated.
8. Uses solid coupling that does not require lubrication.

In Fig. 3 the pump has an inner casing, individually cast for each stage, which makes the case passages accessible for cleaning. If the casing is injured, only the damaged stage need be replaced instead of the complete casing. Vertical pump is the same design as the horizontal double-case pump and uses hydraulic pressure within the pump to keep the inner-case joints tight, eliminating heavy case bolting commonly used on horizontally split units.

Correctly designed boiler-feed pumps, fitted with parts of proper material, should operate continuously for long periods before the first inspection or repair. It is not advisable to open the pump unless a drop in pressure and capacity is indicated on the meters. There are many critical points in the assembly and there is always a danger of damaging these vital parts at the time of assembling or dismantling. Periodic check of bearings, change of oil every six months, and a check on packing keep the pump in good running order.



1 Anhydrous-ammonia cylinders, after being subjected to 30-ft drop on sharp edge of angle iron, could be rounded out by hydrostatic pressure to pass ICC tests



2 Adapter connects cylinder to charging line, saves valve-connection threads

How to Handle Ammonia Safely

Consider these important points when you are faced with the job of emptying an ammonia system for repair. They will also help you in day-to-day operation of your refrigerating plant

By **LEE BRANDT**, Pennsylvania Salt Manufacturing Co

► SAFE HANDLING of anhydrous ammonia depends on how thoroughly you understand three potentially hazardous properties of the refrigerant: (1) toxicity (2) flammability of oil-ammonia mixtures and (3) rapid expansion of liquid.

1. Toxicity. Ammonia odor is so strong and irritating that no one voluntarily inhales dangerously high concentrations more than momentarily. Ammonia is not cumulatively toxic and long-term experience proves that inhalation of low concentrations over many years is not hazardous to the healthy individual.

But inhalation of even small amounts of ammonia is irritating to the respiratory system so people suffering from asthma or tuberculosis should avoid any contact whatever with it. To healthy individuals, the only real hazard lies in the possibility of being trapped in an area of high concentration.

While fatalities can be anticipated if an operator is knocked unconscious by accident and simultaneously exposed to high concentrations, statistics accumulated by the ammonia-producing industry indicate very few deaths directly attributable to ammonia exposure.

The fact that ammonia is irritating provides an automatic warning. Frequently, fatalities from exposure to nonodorous gases, such as carbon monoxide and carbon dioxide, result from lack of warning odor.

The physiological responses to various concentrations of ammonia have been tabulated, Table II, by Henderson and Haggard in *Noxious Gases*, published in 1927 by the Chemical Catalog Co.

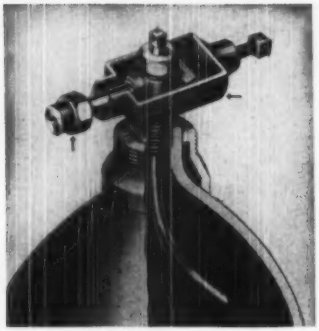
Where employes must work in areas of high ammonia concentration, an ammonia-gas mask approved by the U. S. Bureau of Mines should be available. Preferred location of such a mask is outside the building or room housing the refrigerating equipment. Thus the mask is readily available before entering.

The affinity of ammonia for moisture introduces a source of considerable irritation because ammonia condenses on any part of the body damp from perspiration. For emergency work in areas of high concentration, any such moist body areas should be smeared with oil. Also, this affinity permits the emergency use of a water-saturated bandage across the nose for short periods.

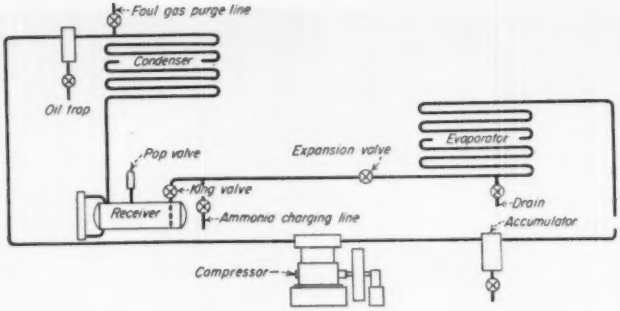
As ammonia weighs only half as much as air, fumes normally travel upward. If it is necessary to enter a contaminated area without a mask, always keep your head low.

In a way, ammonia's odor is beneficial, because any leak of consequence is immediately noticed. Exact point of leakage can be readily determined with ammonia-sensitive paper or a burning sulfur taper.

2. Oil-Ammonia Flammability. From the practical angle, a stream of pure ammonia gas will not sustain its own flame. While the theoretical limits of flammability are from 16 to 27% by volume in air, the fact remains the range is so narrow a flame cannot be made self-sustaining, even intentionally. National Board of Fire Underwriters re-



3 Soft tin seat for cylinder valve prevents long-storage ammonia leakage



4 Piping layout for ammonia refrigeration cycle, such as above, should employ a pressure relief valve in liquid receiver to vent any undue pressure buildup

port on Miscellaneous Hazard No. 2375, dated Nov 13, 1932, gives the complete picture of ammonia's flammability characteristics.

Standard method for determining ignition temperature is to heat a sample of gas in air until a temperature is reached at which ignition occurs. Obviously, this should be done in a vessel that is inert as far as promoting ignition is concerned. Ignition should be due solely to the gas-air mixture and the temperature attained.

With ammonia, there is a slow decomposition beginning at a temperature of about 900 F, yielding ammonia's constituent gases—hydrogen and nitrogen. It will be recognized that hydrogen is flammable. When experimenters mixed ammonia and air in the theoretically flammable ratios in an inert quartz or alundum tube, no ignition was experienced up to 1562 F.

For some unknown reason, they then replaced the inert quartz and alundum tubes with a steel flask. Steel, at elevated temperatures, promotes thermal decomposition of ammonia into flammable hydrogen. When ammonia was heated in an iron flask and sparked, ignition took place at 1203.8 F.

Ever since the publication of these data in 1933, the ammonia industry has bitterly complained that in view of the foregoing catalytic conditions, it could not be said that ammonia ignited at 1203.8 F. Nevertheless, the figures given still stand as official.

To the refrigerating-plant operator this theoretical flammability is further questionable because the burning-sulfur-taper method of finding leaks is almost universally employed. Were ammonia and air readily ignitable, looking for a leak with a burning taper would have been discontinued long ago.

There have been numerous ammonia fires reported in refrigeration plants. But critical examination of the conditions surrounding such fires invariably reveals that the fire was caused by the ignition of an oil-ammonia mixture—not by ammonia alone! Ammonia leaving the high side of a refrigerating compressor is normally saturated with oil from the compressor itself. As the high side of a refrigerating plant is particularly susceptible to leakage, it is natural that ammonia-oil fires occur with some frequency. Leaks of this kind are often attended by electrical failures, sparks from which may ignite the oil and ammonia.

In a previously existing fire, leaking ammonia ignites because of the heat of the primary flame. In other words, if a stream of ammonia gas impinges on a flame, the two continue to burn, but only so long as the primary source of flame continues. When that goes out, the ammonia flame dies out.

The Interstate Commerce Commission classes anhydrous ammonia as a "nonflammable liquefied compressed gas" and shipments carry the familiar green label.

3. Liquid Expansion. Practically all liquids expand on heating. If a fire is built under a skin-full boiler, it eventually ruptures. Similarly, a pipeline full of ammonia, if closed at both ends and heated, ultimately bursts. So where a long liquid-ammonia line may contain trapped ammonia, it is customary to install a safety valve.

Under regulations of the Interstate Commerce Commission, a cylinder of any liquefied gas may be so filled that when heated to 130 F, it is just skin-full. Ammonia cylinders are intentionally underfilled. An ammonia cylinder normally is not skin-full until it reaches a temperature of about 145 F. Manufacturers universally caution against heating ammonia cylinders because overheating is dangerous. In a refrigerating plant, there is no need for heating ammonia cylinders to increase their pressure, but there is a very real hazard when plant operators store ammonia in cylinders during repair periods.

As it is easier to repair refrigerating equipment when free from ammonia, many plant operators make it a practice in the spring to empty the charge into cylinders and go ahead with system repairs. Ammonia manufacturers are placed in an embarrassing position when their customers request empty cylinders for this service. For competitive reasons, it is almost impossible to refuse such a request.

If the plant operator does not weigh the cylinders, he is almost certain to overfill them and a normal temperature rise often bursts a container. Ammonia manufacturers, when supplying cylinders for this service, send detailed precautionary instructions, which are frequently ignored. Where cylinders rupture, there is considerable property damage—and sometimes loss of life.

The ammonia manufacturer who has done his customer a favor often finds himself the defendant in a lawsuit, where the plant operator claims the cylinders were defective and steadfastly maintains they were filled on a scale. Possible cost of such accidents can be considerable and some ammonia manufacturers have taken the undeviating stand that, under no circumstances, will they permit their cylinders to be refilled by customers.

A less convenient alternative is to store liquid ammonia in the receiver and the lower coils of the evaporator while work is done on the compressor and expansion system. Ammonia can be stored in the liquid receiver and the expansion system while repairs are made on condensers.

All heat exchangers and liquid receivers should be provided with pres-

I: HAZARDOUS PROPERTIES OF AMMONIA

1. *Toxicity*—fumes are highly irritating to the point of suffocation.
2. *Flammability of oil-ammonia mixtures*—high side leak often releases flammable oil-ammonia mixture.
3. *Rapid expansion of liquid*—ammonia in liquid form expands rapidly with increasing temperature. Therefore, during repairs, cylinders from a refrigerating plant must be filled with extreme caution.

II: PHYSIOLOGICAL RESPONSE TO AMMONIA VAPOR

	Ppm
Least detectable odor	53
Least amount causing eye irritation	698
Least amount causing throat irritation	408
Least amount causing coughing	1720
Least amount for prolonged exposure	100
Maximum for ½- to 1-hr exposure	300-500
Dangerous for even ½-hr exposure	2500-4500
Rapidly fatal for short exposure	5000-10,000

sure-relief valves. Most liquid receivers are so protected. Frequently a shell-and-tube brine cooler will flood because a float valve fails. If unprotected by pressure-relief devices, a rupturing shell-and-tube heat exchanger can cause tremendous property damage.

Panic. To the user, anhydrous ammonia's odor simply warns of a leak that should be repaired. To the layman, the odor of ammonia conveys the impulse to leave the area immediately. With the passage of time the ammonia-producing industry and the refrigerating industry have come to realize that they must recognize a responsibility to handle ammonia in such a way that it can never become a public liability.

Refrigerating codes in various cities recognize this panic hazard in various ways. Use of ammonia as a "direct" refrigerant in air conditioning is not advisable. A leak in a direct system could introduce ammonia-laden air into a theater with potentially disastrous results. To prevent such accidents, it is desirable to use an indirect system designed so ammonia cools brine, which in turn cools the air. Proper design removes the ammonia from direct contact with the cooling system and prevents fumes getting into a theater or other public building.

In the design of ammonia cylinders, the manufacturer knows he must have a container that will not leak under normal or moderately abnormal conditions. Most compressed-gas cylinders are protected with spring-loaded relief valves or fusable plugs. With ammonia cylinders, however, these two devices have been found inadequate for complete safety.

To get around the necessity for pressure-relief devices, ammonia cylinders have been intentionally underfilled, as mentioned previously. While the ammonia pressure at 130 F is 330.3 psia, shipping cylinders will withstand pressures six times as high. Modern bottle-type cylinders can be dropped 30 feet onto a sharp angle iron without leakage. Recent tests on a new type ammonia cylinder indicate that following such a drop, the dents so produced can be rounded out without weakening the cylinder.

Bulk Movement. Ammonia can be shipped in tank cars of 26-ton capacity which have pressure-chamber walls about one inch thick. They are equipped with spring-loaded pressure-relief valves and protected by four inches of cork with a strong metal sheathing. Tank cars of this same design have successfully withstood railroad accidents without leakage where the car rolled down an embankment.

Recent use of ammonia as a direct fertilizer has appeared to necessitate a relaxation of ICC regulations, and nowadays it can be moved in truck or trailer tank similar to that used in moving propane. In recommending such a change in regulations, the ammonia industry had in mind the application of this type of transportation only in agricultural areas as a means of reducing the cost to farmers.

Whether the movement of bulk ammonia by truck through city streets will receive acceptance by the consuming refrigerating industry—and whether municipal fire department will permit it—remains to be seen.

Construction Materials. Because ammonia attacks nonferrous alloys, the universal material of construction is steel. Piping normally is of extra-heavy steel employing either welded or screwed fittings. Valves normally are steel with lead employed as a soft seat—actually, the lead is built into a button which lifts with the stem. In ammonia cylinder-valve construction, a tin ring forms the tip of valve stem. Valves usually are built so they can be packed under pressure by providing a seat in the open position.

Liquid receivers normally are minimum size; a refrigerating system is designed to hold only that amount of ammonia required for actual operation. And, as mentioned, the entire refrigerating charge frequently is more than the liquid receiver will hold.

Ammonia users confronted with any unusual design problem can obtain technical assistance from any producer, or from the Compressed Gas Association, 11 West 42nd St., New York, N. Y.

VENTING AND DRAINING FEEDWATER HEATERS

Regardless of deaeration equipment a certain amount of noncondensable gases always collects in a feedwater heater. Usually the feedwater heater comes with vent conenctions in the shell. These connections are plugged but only for protection during shipping. Remove plugs and put in a venting system.

There are numerous methods of piping in such a system. The recommended one vents each heater to a common header. Terminal point for the vents is usually in air-cooler section of a turbine condenser. Vent lines should be sized in accordance with vent connections.

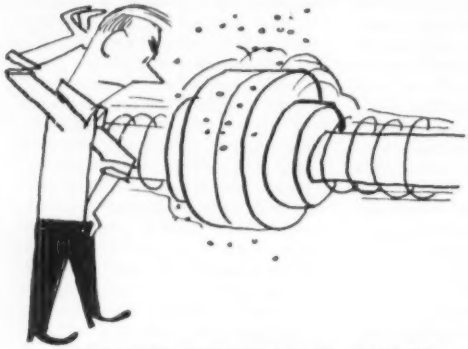
Each vent connection should be fitted with a vent valve. These valves, in turn, should be adjusted according to its maker's recommendations. With a common header, size must be increased as the volume of vents increases.

Heat Engineering, January 1950

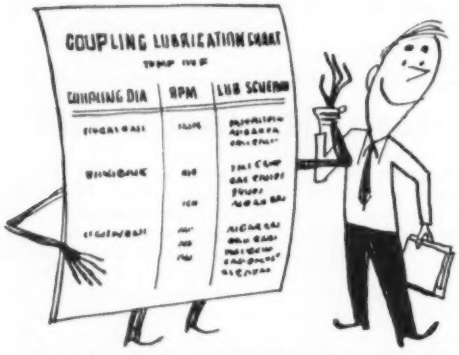
Practical Gripes

Manufacturers of grease and grease-handling equipment probably have information on grease pumpability, separation in flexible couplings, internal friction in grease, as well as proper terms. But they should pass it on to users

WE NEED DATA ON GREASE PUMPABILITY . . .



. . . AND WHEN IT SEPARATES IN COUPLINGS.



THIS LUBE CHART SOLVES COUPLING PROBLEM

► OUR ONE BIG REASON for jotting down some grease snags the power engineer meets is to make the grease and grease-handling manufacturers aware that these problems exist. And any changes they bring about will definitely better our lot in life. For instance, let's look at grease and grease pumping equipment.

Grease Pumping. We found pumping rigs that just couldn't handle many industrial greases. We know right well that a grease should be selected because it will carry through its intended lube job. But we often have to pick it on the basis of what will work in the handling system. To drive this home, consider a ball-bearing grease we recently tested in a hand-packed bearing. Our tests showed up the product in a good light, but we just couldn't use it since the guns would not pump it. In a nutshell, data from the grease manufacturer are not enough to let us, or other users, determine his product's pumpability.

Then, when and if we do determine its pumpability, there's nothing in the grease-handling equipment catalogs to jibe with our data. True, we do find general terms such as "handles the heaviest greases," "will pump wheel-bearing grease," etc. But if grease and grease-handling manufacturers supplied pumpability data it would definitely promote the use of more grease systems in connection with automatic lubrication.

Flexible Couplings. Many couplings require grease. And many coupling manufacturers supply a long list of approved greases. But, generally, their only limitation is temperature. No one tells the user that centrifugal force will separate the grease into soap and oil over a period. This time factor depends on coupling diameter and rpm. For instance, in a 1500-kw turbine at 3600 rpm it took but two weeks to ruin the coupling.

Power engineers would certainly appreciate having a simple chart that would show, in a given temperature range, for how many months couplings of different diameters can be run under various speeds. Engineers could then schedule grease lubrication in advance for about 90% of their couplings.

Bearings. Because of the nature of the beast, friction within a grease under varying conditions of temperature, pressure and flow rate is not easily determined. General manufacture data do not give this important information, hence the engineer cannot predict bearing performance. This was driven home recently after a coal conveyor was installed. Conveyor manufacturer recommended a viscous oil because of slow speed and this oil's tendency to seal out dust.

A quick check showed the required input to the conveyor was about 28 hp. And motor output was 20 hp. Without going into all the details of procedure, at this point we did change to a grease permitting an 8.5-hp reduction in conveyor friction. Although it's a little early in the game to

About Grease

By C L POPE,
*Lubrication Engineer, Eastman Kodak Company**

prove our main point, this simple change should show up as an $8000 power saving during the estimated life of the equipment. Hence, we see that with more data available, use of grease could be extended on the basis of power savings alone.

For the moment let's leave the prelubricated, sealed-for-life bearing for those applications where service conditions can be closely predicted and controlled. In conventional grease-replacement designs, grease is replaced basically because of oxidation, separation or contamination. With this in mind equipment manufacturers should design lubricating devices so it's easy to renew the lube.

Some idea of the work involved in maintaining grease-lubricated equipment may be gathered from the following preventive-maintenance schedule for typical equipment: Portable tools with grease-packed cases are cleaned and repacked every six months, whereas high-speed flexible shaft, 10,000 to 15,000 rpm, are on a weekly schedule. Gear cases for portable and semi-fixed mixers are on a 1000-hr relube schedule where no leakage can be tolerated; six months for operation under other conditions. And electric motors, fans, pumps, etc, range from yearly to five or more years between regreasing periods.

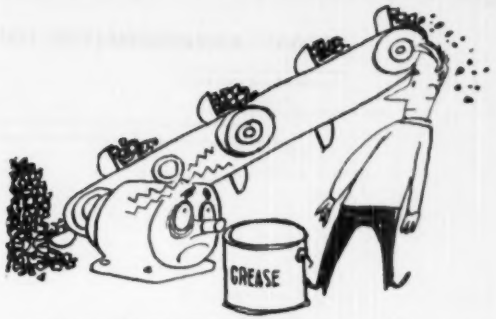
Grease Terms. Many common grease terms can be misleading. It would be a move in the right direction if several new terms were coined for selecting and applying lubricants. For instance, the so-called waterproof or water-resistant greases are generally evaluated by their insolubility in water. Perhaps a better measure would be the ability of the grease to wet the metal when water is encountered. If a grease does not have this property, rusting of ferrous metals generally results. And it is quite possible that a compromise between preferential wetting and water insolubility would give better over-all performance.

The relatively new term, *all-purpose*, is coming to the front. The word is enticing because the average user is not in a position to draw very close lines as to which grease to use for a specific application. Without quibbling over terms, *multipurpose* would appear far more accurate. An inventory of the many greases made by even one manufacturer indicates how far-fetched *all-purpose* is.

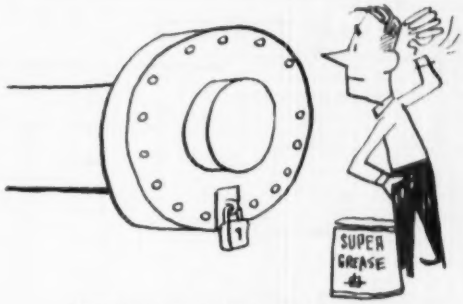
Filler is another term that may cause confusion. Grease manufacturers probably have a clear understanding of just what constitutes a grease filler. But we do not have this advantage, although we can often tell from simple inspection that a grease has more than soap and oil in it.

Of course, some power engineers analyze for zinc, lead, graphite, etc. But without having the main constituents of a grease plainly identified, very little cooperative data can be used as meat for discussion since we just don't know what we are talking about. Hence, it should be possible for the main ingredients of a grease to be made common knowledge without disclosing confidential data on the compounding of the product. It's mighty tough for the user to have to accept the grease salesman's claims regarding an improved grease without knowing what goes into its makeup.

*This article is prompted by Pope's paper presented before the NLGI at New Orleans, October 1949.

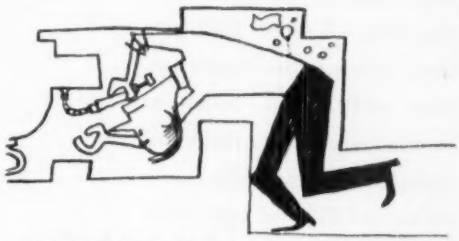


WANTED: DOPE ON FRICTION IN GREASE . . .

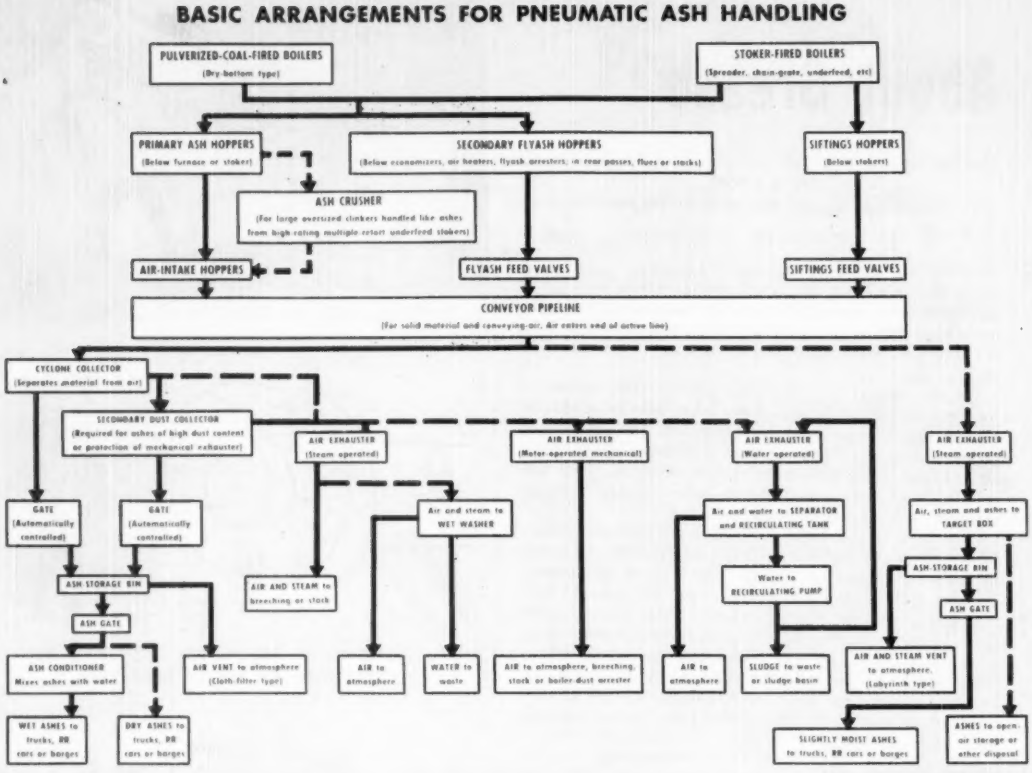


. . . LIMITATIONS OF SEALED BEARINGS . . .

. . . AND A CLEAR EXPLANATION OF TERMS



THEN MAKE IT EASY TO ADD NEW GREASE


BASIC ARRANGEMENTS FOR PNEUMATIC ASH HANDLING
PULVERIZED-COAL-FIRED BOILERS
(Dry-bottom type)
STOKER-FIRED BOILERS
(Spreader, chain-grate, underfeed, etc)
PRIMARY ASH HOPPERS
(Below furnace or stoker)
SECONDARY FLYASH HOPPERS
(Below economizers, air heaters, flyash arresters, in rear passes, flues or stacks)
SIFTINGS HOPPERS
(Below stokers)
ASH CRUSHER
(For large oversized clinkers handled like ashes from high-rating multiple-retort underfeed stokers)
AIR-INTAKE HOPPERS
FLYASH FEED VALVES
SIFTINGS FEED VALVES
CONVEYOR PIPELINE
(For solid material and conveying-air. Air enters end of active line)
CYCLONE COLLECTOR
(Separates material from air)
SECONDARY DUST COLLECTOR
(Required for ashes of high dust content or protection of mechanical exhauster)
AIR EXHAUSTER
(Steam operated)
AIR EXHAUSTER
(Motor-operated mechanical)
AIR EXHAUSTER
(Water operated)
AIR EXHAUSTER
(Steam operated)
GATE
(Automatically controlled)
GATE
(Automatically controlled)
Air and steam to WET WASHER
Air and water to SEPARATOR and RECIRCULATING TANK
Air, steam and ashes to TARGET BOX
ASH STORAGE BIN
AIR AND STEAM to breeching or stack
Water to RECIRCULATING PUMP
ASH STORAGE BIN
ASH GATE
ASH GATE
ASH CONDITIONER
Mixes ashes with water
AIR VENT to atmosphere
(Cloth-filter type)
AIR to atmosphere
WATER to waste
AIR to atmosphere, breeching, stack or boiler-dust arrester
AIR to atmosphere
SLUDGE to waste or sludge basin
AIR AND STEAM VENT to atmosphere
(Labyrinth type)
WET ASHES to trucks, RR cars or barges
DRY ASHES to trucks, RR cars or barges
SLIGHTLY MOIST ASHES to trucks, RR cars or barges
ASHES to open air storage or other disposal

16 Answers to Your Questions on

Pneumatic Ash-Handling Systems

By H R PURSEL, *Manager, Hydraulic Ash-Handling Div, Beaumont Birch Co*

For handling ash and flyash from industrial and small central-station boilers, look over these modern pneumatic systems with motor-, water- or steam-operated air exhausters. Here are basic operating principles and data for easy selection, application in your plant

► WE DISCUSSED pneumatic flyash-handling systems, with manual, semi-automatic and automatic control, in last month's article (June, pp 113-115). We saw that an air stream can periodically remove flyash and dust that accumulate in secondary hoppers under economizers, air heaters and dust arresters, and in rear passes, ducts and stack bases. Ashes from certain types of primary hoppers can also be removed pneumatically. Here we answer basic questions about such systems.

1 For what type ash is the pneumatic system best suited?

It can convey ashes from any stoker- or pulverized-fired boiler if ashes are dry, not molten or viscous. Flow diagram shows basic arrangements. Modifications are made for special conditions —see sketches on pages 92 and 93.

Pneumatic systems can't convey wet ashes quenched by ash-hopper water-sprays. The fine, wet dust packs in conveyor elbows, plugging the pipeline. Ashes and flyash must be dry before being fed to conveyor pipe. Pneumatic system can't handle molten slag from slagging-type pulverized boilers.

If firing equipment produces large quantities of oversized material, like

ashes from high-rating multiple-retort underfeed stokers, a clinker crusher is used between primary ash hopper and ash intake. It eliminates manual labor to break large lumps down to 3- to 4-in. diameter maximum size which can be conveyed at normal air velocities.

2 Which hoppers does usual pneumatic system serve?

Both primary and secondary hoppers of any boiler or group of boilers. Fly-ash conveyor branch pipelines, as well as those from primary ash hoppers, connect to main conveyor pipeline. Then, both types of materials are conveyed, processed through same equipment.

Major field of use is in industrial and small central stations. Low first cost, flexible arrangement, small maintenance and simple operation favor its use there.

3 What ash- and flyash-conveying rates are used?

Rates depend on particle size, ash density, inside diameter and length of conveyor, number of elbows and type of exhauster. Capacities for primary hopper ashes range from 6 to 9 tons per hr in 6-in.-diameter conveyor pipes, 10 to 15 tons in 8-in., and 18 to 25 tons in 10-in. pipes.

Flyash from secondary hoppers is conveyed at rates two to three times that for primary ashes. Rates are for average conditions and usual air velocities. Smaller size or lighter ashes, shorter conveyor lines and higher air velocities permit higher rates. Reversed conditions reduce rates.

4 How do pneumatic ash-handling systems operate?

Dry ash and flyash from furnace and boiler accumulation regions drop into storage hoppers until periodic removal to disposal. High-velocity air transports ash from hoppers to disposal or storage. Air exhauster maintains flow through conveyor pipeline at negative pressure. Pipeline is enclosed except for air intake at end and ash-intake openings located where needed. Negative pressure produces inward air-flow at intake opening, and special air lock is not needed. Simplicity of ash intake is one principal reason for conveying at negative instead of positive pressure.

Same conveyor pipeline and branches serve all ash and flyash intakes in system. Material is fed to one intake at a time, all others being closed by removable plugs or gates. Sometimes flyash is mechanically fed from two or more hoppers at same time into same active branch pipe. When operation moves from one branch to next, inactive branches are segregated from main line by valves or by closing intakes.

Primary ashes are often mixed and of uncertain size, and an operator is needed to control ash flow from primary hopper to ash intake. Intake is usually in front of or below ash-hopper door.

5 What kinds of hoppers and ash intakes for large boilers?

Walls slope to direct ashes by gravity flow to an opening at wall bottom. Opening is above conveyor pipeline, intake hopper and grid. It is generally closed by a refractory-lined door traveling on rollers up and down frame tracks on hopper wall. High-temperature furnaces use watercooled door frames.

In operation, attendant controls ash flow by regulating gate opening. Oversized clinkers remain on intake grid where he hoes them aside for later breaking. Or he can immediately break them to size to pass grid into conveyor. Ashes flow by gravity into conveyor pipe through a T-fitting—the ash intake.

Nonclogging-type intake, called self-feeding, has inlet offset to feed ashes into side of pipe. This design prevents material filling conveyor pipe and blocking conveying air flow. Air flow past ashes entrains solids and starts them moving through conveyor.

Attendant also observes ash-flow rate. Reduction in rate or stoppage is usually caused by arching or packing in ash hopper above the gate. He restores normal rate with a poke bar or hoe, or by changing door position. Gate may be manually operated by handwheel and gear. Door's own weight closes it when handwheel is reversed. Or gate may be power operated by air or water through a cylinder, piston and rod.

Steel dust enclosure surrounds gate and space above intake grid. Access plate in front wall of dust enclosure permits attendant to watch ash flow.

6 What type hopper for smaller boilers producing less ash?

For small quantities of ash, or where boiler produces abnormal amounts of oversized material, hopper is shaped to retain ashes when door is open. Attendant hoes ashes through door onto intake grid. Walls can usually be cricketed to gravity-flow ashes almost to door, reducing hoeing distance. Arrangement often includes a hinged, refractory-lined door and omits dust enclosure. Inward flow of air past open door carries most air-borne dust into furnace. Sheet-steel skirt plates along sides of door between hopper wall and edges of grid prevent ashes falling to floor.

Flyash feeding from secondary hoppers to air stream is automatic, requiring no attendance other than opening and closing valves or starting mechanical feeders. Automatic sequence control of these valves is available to eliminate all manual attendance (June, pp 113-115). Motor-operated star feed-valves or automatic air-jet entrainment in feeder body feeds flyash. At ash intake, high-velocity air stream entrains solids and accelerates them to conveyor velocity toward exhauster.

7 How do collection methods using cyclone separators work?

The ash-laden high-velocity air stream tangentially enters the cylindrical section of cyclone collector near the top. Inertia and change in direction cause solids to cross air stream and collect on inner wall of top section. Sudden expansion of air in collector lowers velocity and ability to suspend particles. Solid material drops from air and collects in conical-hopper bottom. It is discharged from here by interrupting air flow for 5 or 10 seconds. This equalizes air pressure on both sides of a hinged, counterbalanced bottom door. Weight of collected material opens door for gravity flow to atmospheric-pressure storage bin. Without weight of material, door closes.

Resumption of air flow lowers air pressure on separator side of door and seals it to retain material for 1 to 2 minutes when discharge again occurs. Cycle repeats under automatic control of a repeating time switch.

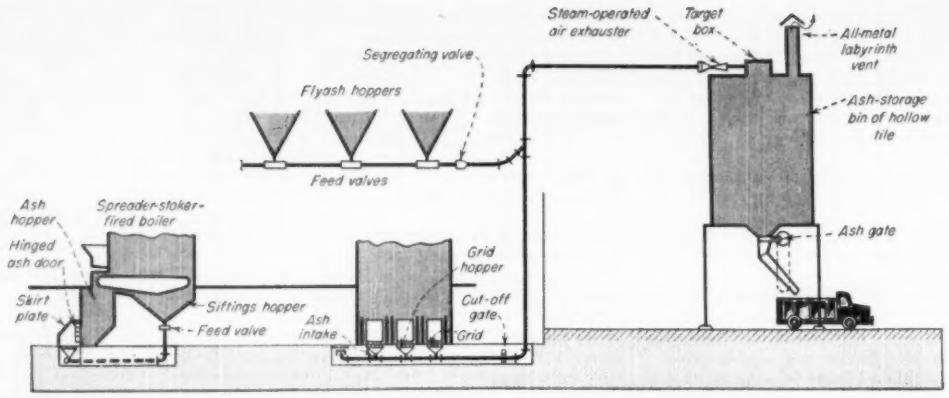
Continuous-discharge air locks have been used, but simplicity and low cost of interrupted conveying led to wider use.

Cyclone collector discharges dry material to storage bin; neither steam nor moisture contacts the ashes. Dry storage is needed when material contains large amounts of fine ashes or flyash because wet material won't flow freely through ash-bin discharge gate.

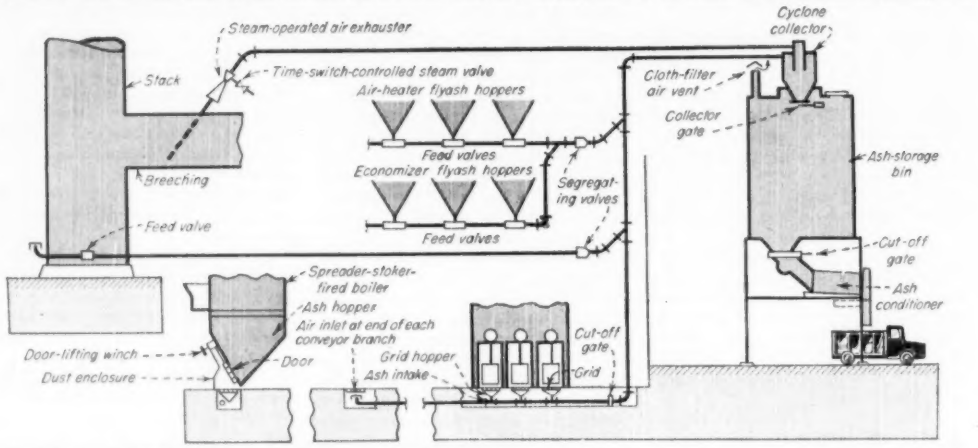
With high dust-content ashes, a secondary dust collector, single or small-diameter multiple-centrifugal type, is in series with primary collector. Secondary dust separator automatically discharges dust to storage bin when primary separator does. Separation occurs along outer walls of cyclone; hence second-stage small-diameter collector may be inside first stage.

8 When are wool or cloth secondary filter-separators used?

They may be used when handling flyash only. Continuous filtering of incandescent or hot particles from primary hopper ashes destroys wool or cotton. Other cloth materials that resist



STEAM-OPERATED AIR EXHAUSTER discharges ashes, air and steam to bin. Moist materials stored in bin, then loaded directly to trucks. Bin is vented to atmosphere



STEAM EXHAUSTER: DIRECT DISCHARGE of air and steam to breeching. Dry materials stored in bin and water-conditioned for loading to trucks or cars

heat do not have mechanical properties to give satisfactory service under frequent shakings. Usual practice automatically opens secondary collector gate and shakes filter bags each time ashes are discharged from primary cyclone separator.

9 How do collection methods with steam-operated exhausters work?

Eliminating cyclone collector, discharge gate and timer, it delivers ash-laden air directly to the combining chamber of a venturi-type steam-operated air exhauster. Steam, air and solids pass through exhauster into a short conduit that centrally enters one side of a rectangular target box bolted to ash-bin top. Wearing plate on inside of opposite wall takes mixture impingement. Box is closed on all sides and top, but open at bottom for mixture to enter storage bin. Conveying is a continuous process.

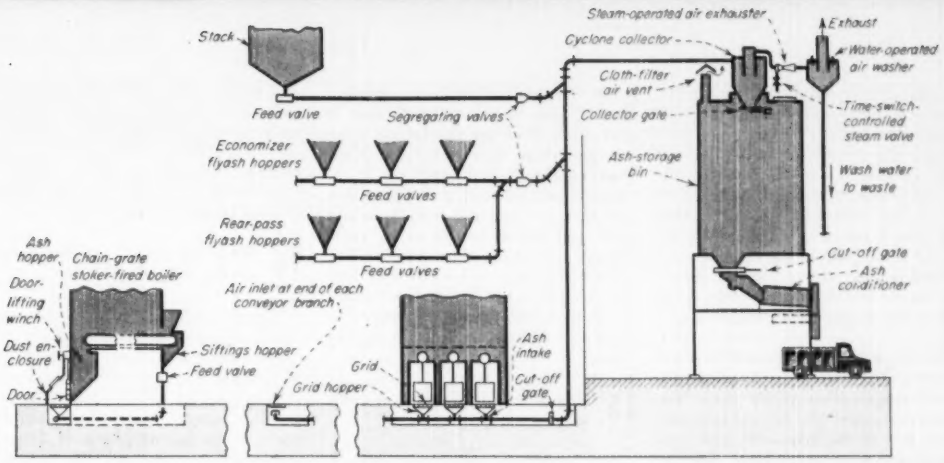
Expansion of steam and air as they enter bin drops material out of suspension. Air and remaining steam discharge to atmosphere through an all-metal labyrinth vent. Water sprays may be used in vent to wash air and condense steam before exhausting. Wash water is discharged to waste.

This method of discharging ashes to bin is the least expensive for pneumatic handling and is often used for small stoker-fired boilers with low ash and dust quantities. It should be used only for granular ash, which does not pack when moistened. Since bin-ash contains some moisture from the steam, it is often discharged from bin gate to an enclosed chute. Then it goes to trucks without use of an ash and water mixer. Flow diagram shows application of steam-, motor- and water-operated air exhausters and disposition of wash water, spent steam and air.

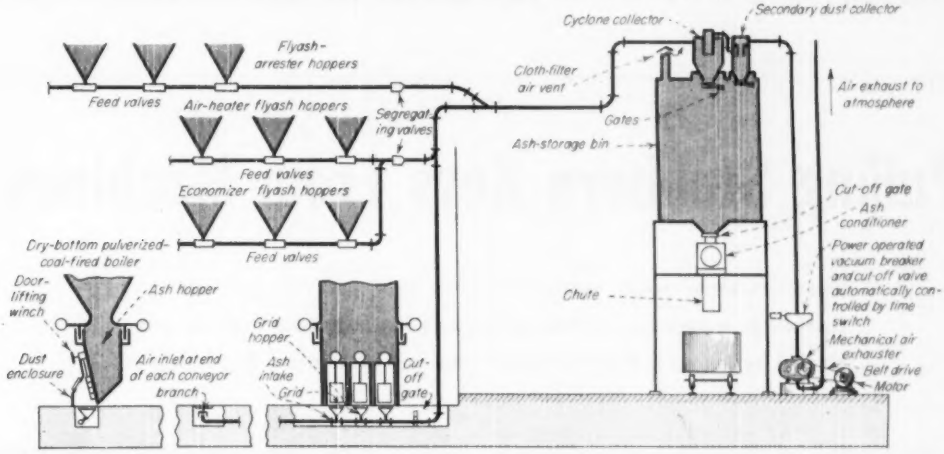
10 Which type of exhauster is the commonest?

Steam-operated units are most widely used because first cost is low and no auxiliary power is needed. Steam pressure should not be less than 90 psi, and preferably 100 psi or higher. Steam-flow rates vary between 2500 and 4000 lb per hr, depending on material size and density, conveyor diameter and length.

11 How do motor-operated exhausters work in pneumatic systems?



STEAM EXHAUSTER: WASHED DISCHARGE **Exhauster discharges air, steam to water-operated air washer. Bin vented, conditioner loads to trucks, cars**



MECHANICAL AIR EXHAUSTER **motor-operated, discharges clean air to atmosphere. Dry materials stored in bin and water-conditioned for loading to trucks or cars. Bin vented**

Motor-operated units, generally the constant-volume variable-pressure type, are driven by normal-torque squirrel-cage induction motors through V-belts. They are more efficient than steam exhausters; no steam is lost to atmosphere. Air is exhausted at higher vacuum ranges, an advantage with long conveyor pipes.

12 How do units work that are operated by water?

They entrain in water the fine-dust carryover from the separators and discharge almost dust-free air to atmosphere. Water may be recirculated to prevent waste. For recirculation, exhauster discharges water and air to a surge tank where air is released to atmosphere and water flows to suction of recirculating pump. Pump delivers water at proper pressure to exhauster nozzles to complete the circulation.

Recirculating pump should also be used to transfer sludge from surge tank to waste. Sludge-removal frequency depends on amount of dust carryover to surge tank.

Centrifugal recirculating pump is of abrasive-resistant design to resist action of fine silt. (See hydraulic ash-handling article, May, pp 83-86.) Sludge is pumped to waste or a basin alongside boiler house. From here water seeps to lower levels.

13 What material is used for ash bin in pneumatic system?

Storage bin may be of hollow tile, steel plate, steel-supported cast iron or other material. Low cost and ease of erection of hollow tile have led to wide acceptance of this type.

14 How are hollow-tile bins usually constructed?

Supporting tower and bin bottom is of reinforced concrete or structural steel. Columns are any height needed for vehicle clearance and for chuting material to vehicles. When supporting tower is steel, bin bottom is concrete supported on transverse structural-steel members. Roof is reinforced concrete or concrete slab supported on similar members, and has ash-inlet openings.

Bin bottom has opening for a steel hopper to which discharge gate is attached. In bins for moist ashes, hopper bottom may have a steam jacket to pre-

vent gate door freezing shut in winter. Bottom is square or rectangular and supports bin walls.

Walls are hollow radial tile, 6 in. thick, in 12x12-in. or similar size. A channel is molded in top of each radial tile. As each course is laid, one or two steel girth rings to take tensional load are laid in the channel and embedded in portland-cement mortar. Inside diameters commonly used range from 8 to 24 ft in multiples of 2 ft in small diameters, and 1 ft in large.

Wall tile is salt-glazed to seal surfaces against moisture. Surface is heat- and corrosive-resistant. Dead air spaces insulate moist materials, prevent freezing.

Ash gate at bin bottom is roller or pivoted type when ashes chute directly from bin to trucks or cars. Usually, gate is operated manually through a shaft and chain wheel from grade. Alternate piston operation of gate is available. Manual slide or roller cutoff gate is used when ashes are discharged to an ash conditioner. It is closed only when conditioner parts need checking.

Besides ash-entrance openings in bin roof, there is a manhole with frame and cover, and one or two air vents. Vents maintain atmospheric pressure in bin. Dry-ash bin vents are cloth-filter type with arrangements for manual shaking of the bags. All-metal labyrinth vents are used in bins for moist ashes, air and steam.

15 How is dust suppressed and fly-ash mixtures discharged?

Ash conditioner suppresses dust. It meters dry-material flow from bin bottom, has a mixing chamber fitted with water-spray nozzles and a power-operated agitator. Agitator continuously exposes dry surfaces of material to a fine water spray. Ash conditioner's retention time is enough to moisten all particles without producing too fluid a mixture. Conditioned material is discharged through an enclosed hood and chute.

16 What are unit's capacity, power needs, water flow?

Capacity most often used for ash conditioners is 20 to 25 tons of dry material per hr. Larger sizes handle 40 to 50 tons per hr. Power needs are about 1/3 hp per ton of dry materials per hr. Water needed depends on material's dust content and ranges from 1 to 2 gpm per ton of dry materials per hr. Water pressure should not be less than 20 psi at conditioner when nozzles operate at full capacity.

Pulling Stubborn Keys From Machines

Here are some good, practical tips on how you can pull out keys from large equipment without damaging key, keyway, shaft or gear, as told by James P Marshall, plant engineer of Warren, Rhode Island

► EVERY SO OFTEN you find yourself face to face with the job of dismantling some heavy machinery. Wherever you can, you like to get some return for the work you'll put in by salvaging gears or shafts for later use. You'll find one of your biggest headaches is pulling out the keys from keyways—especially so if the keys are large and long and have stood undisturbed for some time, possibly for years.

Wedge Removal. The commonest key you'll find in the heavy machinery field is the so-called head key. Fig. 1. This key is made by adding some extra length to a tapered key and putting a step on one face. The head formed by this step plays an important role in drawing the key out. Or, at least it's supposed to.

If everything goes all right, you take a wedge and put its point between the step and the gear or shaft. As you drive the wedge down the key comes out. Just like that.

But the only sure way of getting such quick results is to have a key properly made and set in the first place. Both key and keyway should taper. The key should fit the keyway perfectly. Head and step must be in good condition. And when the key is driven home the driving force should be applied with discretion.

For a key-pulling wedge to be effective it should be quite long and with a very small taper. If it tapers too abruptly it will not take a bite between step and gear. In fact, it will probably bounce out each time you hit it.

We prefer to leave off the head when we make up a key. We drill and tap a hole at the exposed end of the key. Then fit the key so it makes a flush fit with the end of the keyway. Fig. 2 and 3 show drilled key examples.

Driving Rigs. With such a key you can set up a simple, inexpensive rig to drive or pull it. Fig. 2 shows a rig we developed. It consists of a piece of rod threaded at both ends. One end fits the tapping in the key. The other takes a nut and a substantial steel washer.

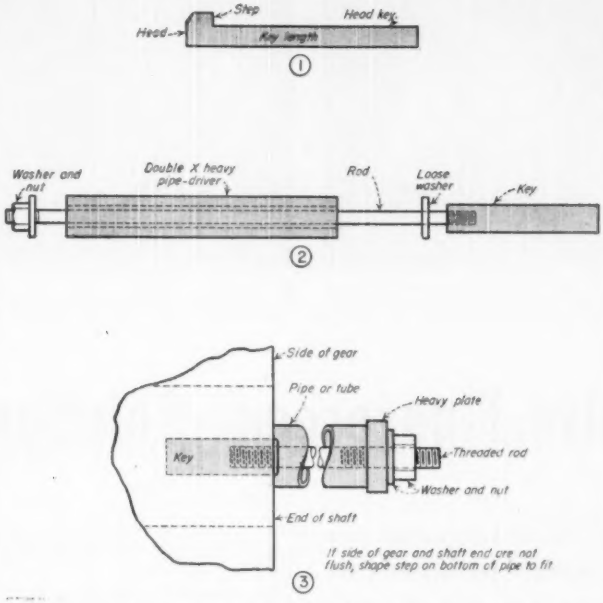
A double extra-heavy steel pipe slips over the rod. But before slipping on the pipe we put a heavy washer ahead of it, to act as a buffer between pipe and key. Completed assembly is shown in Fig. 2.

We hold the rod length to a size that gives us room for a free swinging action. The pipe slides back and forth as we drive it against the washer and nut end. The buffer washer between key and pipe protects the key surface from the bouncing pipe. This pipe's length and weight we vary with the job at hand.

Removal by Heat. Suppose, though, the key won't come out even with a driving rig? Then you apply some heat to the member. It helps enormously. The quicker you can heat the gear hub, the better the results. The idea is to hold the shaft as cool as possible while heating the gear hub. So put all the heat to work at once.

Two good gas torches, one held against

SAMPLE KEY AND WAYS TO DRAW IT OUT



The commonest key for heavy industrial equipment is the head key, 1, above. A wedge between step and gear is supposed to take it out. Another way is to drill and tap the key, and then put together a driving rig, 2, to yank it out. Still another way is to use a key puller, 3, and force the key out

the gear hub nearest the keyway, and the other moved around the part, will probably do the trick. In the meantime, keep wedging or driving.

Key Puller. If you haven't enough room to operate a driver, as above, you can work up a variation of gear-puller, Fig. 3. Thread a rod to fit into the tapped key and then thread the other end for quite a little way along its length. Get a pipe large enough so the key can run through it with no difficulty and slip the pipe over the rod. Put a heavy washer with its metal surface wide enough to bear solidly against the pipe rim over the puller rod. Then run a nut along the threaded rod until it presses against the washer. As you take up on this nut it exerts a pull on the key until finally the key is free.

Any operation, though, that involves screwing a rod or stud into a tapped hole and then applying strain, carries with it the likelihood of damaging the threads or, in the extreme, stripping them entirely. You can best prevent this by seeing that (1) threads are clean and full on both the stud and in the tapped hole (2) stud or rod screws into the key far enough to give a strong hold on the threads.

If the tapped threads become chewed up you can drill and tap a deeper hole for new threads. Or drill and tap the original hole to the next larger standard bolt size. If you take the last step you'll have to get a new stud or rod.

Welded Studs. Where you have no access to machine tools or haven't room enough to drill or tap, you can get by with a stud placed in the rough hole and then completely welded around. Use plenty of metal in the welding. A thin circle will pull out.

You can carry this idea still farther. If drilling and tapping the key is impracticable right from the outset, you can weld a stud directly to the exposed end of the key. Welding has to be first class to stand up under the pull-out strain. One way of being sure of a good weld is to taper the stud practically to a point. Then attach the point to the key. Build up your weld around the stud carefully and you'll get a good bond with the key.

For a really stubborn key that won't move for any of these methods, try inserting a metal piece behind the key in the key slot. This metal piece is held firmly against the key by means of a small jack or a wedge set against the equipment frame or similar firm member. The idea is to keep the key from moving inward.

With the key held firm in this direction strike the gear hub with a heavy ram of brass or bronze. This drives the gear hub farther on the shaft and away from slope of the key taper. The key may then loosen enough to allow wedges or a key puller, such as is described above, to draw the key out.

Drilling Out. If all these steps fail you may have to drill the key out. This can be a laborious, time-consuming job. But if you have to do it at least drill to a pattern.

If you have a relatively small key, run through a small lead hole and follow it up by a drill as near the key size as you dare. But don't cut into the key walls. The closer the drill size to the key size, the easier it is to weaken the grip of the key.

If the key does lose its grip, you may succeed in forcing off the gear and carrying the weakened remnant of the key off with it.

Where the key is too large for the one-hole technique, drill a series of holes along one face of the key side by side. It is always best to follow the tapered face so the key will collapse enough to let you draw the gear off. If the key is tapered and does not move with the gear any drawing action on the gear will only run it farther up the key-slope and set the key harder.

While a gear or shaft is headed for the junk pile, the most effective drilling is with the drill point centered at the line between the key and the part to be discarded. This way, you take metal from both parts and speed up the entire operation.

A pinion gear of modest diameter scheduled for scrap can be loosened fairly quickly by drilling a series of holes closely spaced along the valley between two teeth. The best place for this drilling is directly over the key. But that depends on whether or not the pattern of teeth permits it.

When drilling is finished you can wedge open the gear and slit along the drill if the gear is cast iron. If it's steel a cutting torch can remove metal between drill holes and so weaken the gear that it can be drawn off.

1 After shutting down turbine and condenser, turbine exhaust-casing manhole cover is removed. Level of solution in condenser steam space is checked from manhole

2 Fluorescein mixed in this container is pumped into condenser steam space

How Inexpensive Fluorescent Solution

New method speeds up testing and reduces unit outage time from hours to minutes. These step-by-step instructions show you how to find condenser tube leaks faster in your plant

By **H T DUPLICE**, *Superintendent*
and **R C ALEXANDER**, *Mechanical Engineer*
Harbor Steam Plant, Bureau of Power & Light
Department of Water & Power, Los Angeles, California

► HARBOR STEAM PLANT has five major generating units, each with its own 2-section condenser. There are 55,428 tubes to check when leakage occurs. For more rapid and positive detection of leaks we tried a fluorescent solution.

Old Tests Too Slow. We used the usual methods, including candling, hydrostatic tests and leak detectors. None did the trick. Either too much time was needed or results were not positive.

Numerous small leaks caused us the most trouble. For these, we got best results by taking unit out of service, filling condenser steam space with water and examining tube ends on waterbox side for leaks. Each tube was air-blown free of water and tube-sheet face dried. Small leaks were then visible. Extra time needed, over other methods, was justified by effectiveness. But load conditions often prevented taking faulty unit out of service for the needed eight hour examination period.

New Procedure. To reduce outage time, we experimented with hydrostatic-fluorescent inspection. This method reduces outage time and detects all-size leaks.

Procedure is: (1) Shut turbine down. (2) Break condenser vacuum. (3) Shut off cooling water. (4) Drain waterboxes and remove exhaust-casing manhole cover. (5) Fill steam-side with city water. (6) During filling, inject concentrated solution of fluorescein into filling line at a rate that gives a concentration of 10 ppm in full condenser. In our tests, needed amount of fluorescein was dissolved in 8 gal of water and pumped to fill line, Fig. 5.

Condenser is vented to ensure submergence of all tubes. High-water level in steam space is needed for sufficient hydrostatic pressure on leaks.

With condenser full, inspector enters waterboxes carrying a beam-projection-type ultraviolet light and small water hose. Without air-blowing tubes or drying the sheet, and free of white light, he projects the light beam into tube ends. He starts at top of condenser and works horizontally across, from top down, Fig. 4.

Leak Detection. In-leakage of fluorescent solution appears as brilliant yellow-green or red light, indicating failed tube or other leak. Leaking tube is plugged with wood or fiber. Remaining fluorescent solution is washed from tube sheet with hose. The light is then moved across sheet and down to locate other leaks.

The first rapid check locates all large and small leaks. Tube sheet is then flushed with water and a second check made to locate pinhole leaks. Solution escaping from large leaks is easily flushed away; it does not interfere with spotting pinhole leaks.

Interference. During checking, fiber tube plugs, grease and oil spots, certain sea life and shells appear fluorescent. In our tests all these have been a yellow-green color and none interfered with tube-failure checks. To prevent all interference we now use a red fluorescent dye, which gives a visible light of brilliant red. This differs from all natural fluorescent materials we've met so far. Sea shells, also harmful to condensers, appear as if illuminated by natural white light, speeding detection and removal.

Actual inspection time has been reduced from four or five hours to about 30 minutes. Small leaks, which couldn't be located by other methods, are quickly found. Number of men needed for checking is also reduced. Solution is easily and quickly prepared in plant.

3 Operator, *at left*, is holding ultraviolet inspection lamp in proper inspecting position; other operator holds water hose. Normally, one man uses hose and lamp

4 Inspection path for ultraviolet light in checking condenser tubes for leaks

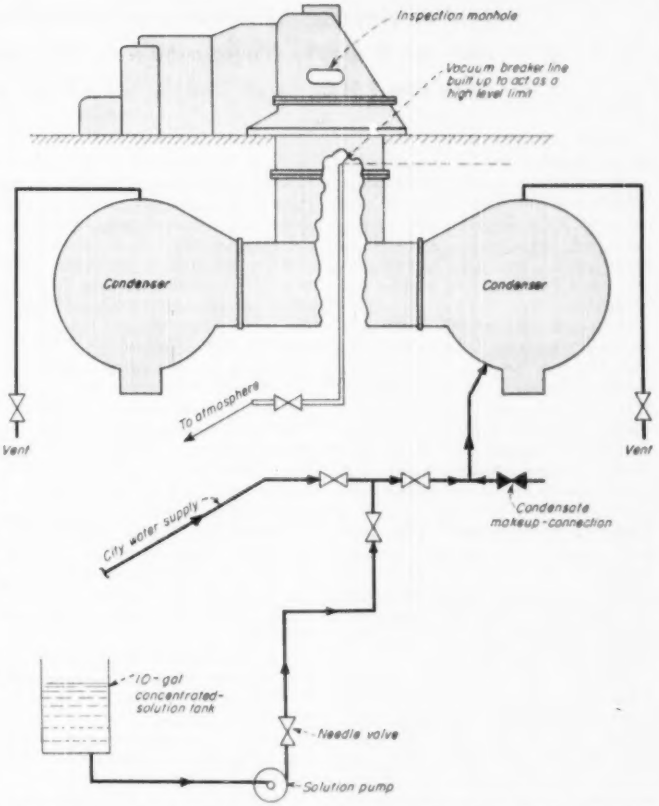
Spots Condenser Leaks Quickly, Surely

Fluorescent Salt. Fluorescein is a yellowish-red crystalline compound, $C_{20}H_{12}O_5$; its alkaline salt is water soluble. Under ultraviolet rays it emits visible light, the color depending on the type of dye used with the fluorescein. It may be red, green, yellow or blue. Solutions are nonpoisonous and nonadherent.

The "practical" grade, water-soluble, concentrated form of the salt was used in varying concentrations down to 5 ppm. This concentration is the weakest usable and has a low cost. One pound of fluorescein, costing $6.50, treated 12,000 gal of water which was reused repeatedly.

Light Source. The lamp was a General Electric Type HGCH4, reflector-spot mercury-vapor unit fitted with a Corning Glass FS 5 ultraviolet filter. A suitable holder prevents mechanical damage and wetting. Grounding the system protects the operator from shocks. The mercury-discharge lamp is used in conjunction with a suitable transformer. Lamp and filter combination emits a small amount of visible purplish light and a beam of harmless invisible long-wave ultraviolet light. This excites the fluorescent solution causing it to give off brilliant visible light.

The method is still in the experimental stage but results are very satisfactory. Since the materials for leak detection are harmless and inexpensive and fewer men are needed for testing we intend to continue our studies.



5 Piping layout to check condenser leaks in Harbor Steam Plant. Fluorescein solution, mixed in 10-gal tank, is pumped into city-water line supplying condenser

ACID CLEANING boiler surfaces has many positive advantages, so when it left an objectionable film, controls were started

LABORATORY TESTING boiler metal specimens indicate certain points where controls can be used and what materials help

New Controls for Tube-Film Deposit

Acid cleaning of metal surfaces is an accepted, rapid maintenance tool. But it usually leaves behind an objectionable black iron-oxide film. P H Cardwell, Dowell, Inc, tells you ways to control it*

► ACID-WASHING BOILERS to remove iron oxide and sludges usually leaves behind a black iron-oxide film on internal metal surfaces. Some protective film is necessary. But under certain acid-cleaning conditions it is heavy and spotted. How can this black iron-oxide film be controlled?

Let's look first at the usual acid-washing procedure. It starts by filling the unit with weak hydrochloric-acid solution containing an acid inhibitor. If it is necessary to take off deposits, a surface agent and a fluoride intensifier are added. Solution stays in the unit until all scale deposit is removed. It is then drained, the boiler rinsed twice with water, and followed up with a weak alkaline after-boil. This after-boil, usually 1% soda-ash solution, neutralizes the acid and acts as (1) detergent to remove loosely held scale (2) help toward passivating the metal surface. The iron-oxide film forms during the three draining steps.

With this much as a starter, we made a laboratory setup so boiler-tube experiences could be studied and possibly controlled. We cut up a 2-in. OD boiler tube (ASME specification SA-83A) into rings, three inches long, and cleaned them with acetone to remove any grease, oil or protective coatings. We then suspended these rings in two liters of acid in a test container held at 150 F. Next, various inhibited-acid solutions were tried to simulate the different partly spent acid solutions you find during the draining steps.

When we came to study the black iron-oxide formation we used three different procedures: (1) normal method for acid-washing outlined above (2) water as the displacement fluid (3) nitrogen as the displacement fluid.

1—Normal Procedure. Most of our tests employed as closely as possible the usual acid-washing method. We immersed the tube rings in acid for four hours. Then we drained off all acid in contact with the ring but not all acid from the bottom of the container. Then the test section of boiler metal stood in the vapors coming off the acid solution for one hour. This simulated the stage in normal acid-washing where the acid vapors contact the metal during acid draining.

Next, we removed all acid from the test container, filled the container with water, and drained it to where no water touched the specimen but some lay in the bottom. The ring remained in this moist atmosphere another hour. This condition, we felt, was similar to that experienced by boiler tubes during the draining of the first water rinse.

We repeated the procedure for a second water rinse and left the boiler tube sample in that atmosphere for another hour. Again we were trying to duplicate actual boiler conditions during the second rinse stage.

Finally, we suspended the metal specimen in an after-boil solution and boiled the solution for one hour. After an hour's exposure we removed the ring and let it dry in the air. With the aid of a wire brush we scrubbed off all film that formed. We collected and weighed it. Various after-boil solutions were used to determine the effect of different materials on the formation of black iron-oxide film. Table I.

A reddish-brown film formed on the metal surfaces after exposure to acid-air vapors and moist air. Film coating weighed 3.56 grams per sq ft of surface. It contained by X-ray analysis 55% magnetic iron oxide (Fe_3O_4) and 45% gamma iron oxide (lepidocrocite $Fe_2O_3 \cdot H_2O$). This coating was what you'd normally expect under these conditions. If, however, vapor temperatures varied, it changed the kind of iron oxide deposited. With vapors at 150 F a film of magnetic iron oxide and gamma iron oxide formed. At 80 F it was 100%

*Abstracted from the paper "Prevention of Black Iron Oxide Deposits Following Chemical Cleaning," by P H Cardwell, Dowell, Inc, before the Midwest Power Conference, Chicago, Ill., April 5-7, 1950.

Two Recommended Ways to Reduce Deposit

Nitrogen Displacement Technique

1. Equip boiler so each waterwall can be drained individually
2. After acid-soaking period introduce nitrogen to the boiler (Connect nitrogen cylinders to a manifold; introduce gas to vent line on steam drum)
3. Build up nitrogen pressure in boiler to 5 psi
4. Open drain lines. Drain individually if step one has been done
5. Displace acid until gas shows at each drain
6. Supply water through acid-fill lines to displace gas out top of drum vent line until water shows
7. Introduce nitrogen to displace water
8. Bring in water for second rinse (same as step 6)
9. Same as step 7
10. Introduce after-boil solution to displace nitrogen
11. Fire boiler to 50 psi for one to two hours
12. Drain the boiler

Water Displacement Technique

1. Equip boiler so each waterwall can be drained individually (Usual way: remove one handhole cap from each header, install drain)
2. After acid-soaking period, pump either city water or feedwater to main drum
3. Build up hydraulic pressure to 50 psi or more
4. Open drain lines. If you did step one, drain each wall individually
5. Continue drain until analysis shows no acid in drain water
6. Pump the after-boil solution into the boiler
7. Fire the boiler to 50 psi for two to three hours
8. Drain the boiler

gamma iron oxide that deposited out.

When the next step—after-boil for one hour with soda ash—took place with a tube metal, 55% magnetic iron oxide, 45% gamma iron oxide, the coating became a thin, black, glossy film. It weighed 1.66 grams per sq ft of surface and consisted of 95% magnetic iron oxide and 5% gamma iron oxide.

The soda-ash boil apparently (1) sloughed off the difference between 3.56 and 1.66 grams per sq ft (2) converted the reddish-brown rust to a black film. If the metal surface had only a gamma-iron-oxide coating before the after-boil, the film coating stayed pretty much the same even after the soda-ash boil. It was still reddish with about the same makeup, essentially gamma iron oxide with a trace of magnetic iron oxide.

These tests indicate that during the after-boil stage you have to (1) dissolve iron oxide (2) slough off any that formed during draining of acid and water rinses. Otherwise, with hydrochloric acid washing you'll have a metal surface covered with after-rust. Later, we'll show how it is possible to reduce the amount of iron oxide found in the draining steps.

After-Boil Materials. Table I shows results from using other after-boil materials. Those that did not remove iron oxide following the water rinses gave black Fe_3O_4 deposits. Among them were soda ash, trisodium phosphate, sodium tripolyphosphate, sodium chromate, sodium dichromate, hemi-sodium phosphate and chromic acid.

A test run with 0.05% phosphoric acid as an after-boil produced a black film. It resulted because the acid was not strong enough to dissolve the iron oxide present on the metal surface.

When we went to strong acidic materials as after-boils, we got rid of the iron oxide present after water rinses. But an additional deposit formed either following or during the after-boil stage. As an example, reddish-brown deposits consisting of alpha iron oxide ($Fe_2O_3 \cdot H_2O$) and magnetic iron oxide (Fe_3O_4) formed after draining the after-boil solution. This happened with solutions of ammonium bifluoride, sodium acid sulfate, sulfuric acid, and mixtures of this material with sodium nitrate and ammonium bifluoride. The reddish-brown deposit is the usual rusting of steel that occurs when metals are exposed to strong acids and allowed to dry in the air.

Phosphoric acid and oxalic acid produced respectively iron phosphate and iron oxalate films during the after-boil. Both are rust preventives. So these acids have two advantages: (1) They dissolve any iron-oxide deposits left after the water rinses. (2) They leave

I: EFFICIENCY OF VARIOUS MATERIALS AS AFTER-BOIL SOLUTION

NORMAL ACID-WASHING PROCEDURE AT 150 F. INHIBITED ACID—3.5% HCl, 0.77% IRON

After-boil solution	*Amount of after-rust grams/sq ft*	*Surface coating*	
		Appearance	*Composition*
None	3.56	Reddish brown	Fe_3O_4 & gamma $Fe_2O_3 \cdot H_2O$
1% Soda ash	1.66	Black	Fe_3O_4
1% Trisodium phosphate	1.23	Black	Fe_3O_4
1% Hemi-sodium phosphate	1.31	Grayish black	Fe_3O_4 & phosphate coating
1% Sodium tripolyphosphate	1.21	Black	Fe_3O_4
1% Sodium chromate	1.62	Black	Fe_3O_4, beta $Fe_2O_3 \cdot H_2O$ & chromate coating
1% Sodium dichromate	1.78	Black	Fe_3O_4 & chromate coating
0.05% Phosphoric acid	1.59	Black	Fe_3O_4
0.5% Phosphoric acid	0.42	Powdery gray	Phosphate coating
1.0% Phosphoric acid	0.31	Powdery gray	Phosphate coating
3.0% Phosphoric acid	1.24	Brownish red	Alpha $Fe_2O_3 \cdot H_2O$ & Fe_3O_4
0.1% Sulfuric acid	0.77	Reddish brown	Fe_3O_4 & alpha $Fe_2O_3 \cdot H_2O$
1% Chromic acid	2.54	Black	Fe_3O_4 & chromate coating
0.1% Sodium nitrate + 0.1% Sulfuric acid	0.27	Reddish brown	Fe_3O_4 & alpha $Fe_2O_3 \cdot H_2O$
0.1% Ammonium bifluoride	0.25	Reddish brown	Fe_3O_4 & alpha $Fe_2O_3 \cdot H_2O$
0.1% Sulfuric acid + 0.2% Ammonium bifluoride	0.28	Reddish brown	Fe_3O_4 & alpha $Fe_2O_3 \cdot H_2O$
1% Sodium acid sulfate	0.52	Reddish brown	Fe_3O_4 & alpha $Fe_2O_3 \cdot H_2O$
1% Oxalic acid	1.88	Gray white	Oxalate coating

behind a protective film. Of the two, phosphoric acid was the better.

Too strong a phosphoric-acid solution can give trouble. In the test, Table I, with 3.0% phosphoric acid, no gray-iron phosphate coating formed. A brownish-red alpha iron oxide ($Fe_2O_3 \cdot H_2O$) and magnetic iron oxide (Fe_3O_4) coating developed instead. This indicates the phosphoric acid was not neutralized enough to form a phosphate coating. For this reason, a brownish-red rust appeared usual to an acid-exposed steel surface left to dry in the air.

These tests prove there is a limited range of concentrations of phosphoric acids that can be used. The lower limit, from 0.1 to 0.5%, is the amount that dissolves the deposit set down during draining of the spent acid and its water rinses. Upper limit is the amount of acid that becomes about 50% neutralized during the after-boil stage. Unless the phosphoric-acid solution is spent to this extent it may not form a phosphate coating and could lead to after-rusting.

In this connection we might mention that some low-pressure boilers have reported no black iron-oxide film formation. This may be because phosphoric acid forms when the hydroxyapatite deposit dissolves.

Drain Acid Composition. Table II lists results of a series of tests on the effect of drain acid composition on after-rusting with 1% soda ash as the boil-out solution. With the same acid content the black film, Table II, seemed to increase with an increase in iron content. Further, the more completely the drained acid was spent, the smaller the amount of black film.

This last observation points up the fact that unspent hydrochloric acid content means more in determining after-rusting than does the amount of dissolved iron in the drained acid. Yet the hydrochloric acid and dissolved iron content of drained acid have little effect on how much black film forms.

The rusting that takes place during acid draining and water rinses depends on a number of factors: composition of the acid, as we mentioned above, length of time required to drain the boiler, temperature at which the boiler is drained. Most rusting occurs while the metal surface is wet.

By reducing the exposure time of Table I tests (one hour in acid-air vapors, two one-hour periods in moist air) from three one-hour periods to three 30-minute ones, after-rust film dropped in weight from 1.66 grams per sq ft to 0.42. Then reducing the exposure periods to three 15-minute periods lowered after-rust deposits to 0.25 grams per sq ft. So the more rapidly the acid and water rinses drain off, the smaller the amount of rusting.

Composition of the boiler steel has a definite bearing on how much rust forms before the after-boil stage. For instance, in Table I with SA-83A, steel rust amounted to 1.66 grams per sq ft, and with SA-192 it totaled 1.52 grams per sq ft for the test specimens.

Since so many factors affect rusting you can't accurately predict the amount of black film. But from all laboratory tests it seems the shorter the time the wet metal surface lies in contact with the air, the smaller the amount of film.

When an alkaline after-boil is used, composition of the film formed depends on the composition of the rust set down during the draining of acid and water rinses. The rust composition, in turn, depends on the temperature at which it develops. The higher the temperature, 130 to 160 F, at which draining takes place, the greater the magnetic iron oxide in relation to other oxides in the film. So the higher the temperature of the drainings, the blacker the iron-oxide film.

The lower the temperature, 100 to 130 F, the smaller the amount of magnetic iron oxide and the greater the gamma iron oxide present. This gives a more reddish iron-oxide film. It also explains why sometimes reddish and even mixtures of red and black film appear.

Black-Iron-Oxide Control. One serious disadvantage to the above procedures is that all rust formed during the draining steps is metal corroded from the boiler parts. Even if all rust formed dissolves during the phosphoric-acid after-boil, it

II: EFFECT OF ACID CONCENTRATION, IRON CONTENT ON BLACK FILM FORMATION

Drained acid solution		
Hydrochloric acid content, %	*Iron content, %*	*After-rust grams per sq ft*
3	0.26	1.57
3	0.51	1.67
3	0.76	1.75
3	1.01	1.81
4	0.26	1.74
3	0.51	1.67
2	0.76	1.49
1	1.01	1.32

Normal acid washing 150 F, 1% soda ash after-boil solution, Fe_2O_3 black film

III: AFTER-BOIL SOLUTIONS TO PREVENT RUSTING ON OUTAGE

After-boil solution	*Total amount of after-rust grams/sq ft*	*Rusting during 10-day period*	*Composition of film after 10 days*
1% chromic acid	0.03	none	Fe_2O_3, chromate
1% sodium chromate	0.04	none	Fe_2O_3, beta $Fe_2O_3 \cdot H_2O$ & chromate
1% sodium tripolyphosphate	0.08	none	Fe_2O_3, gamma $Fe_2O_3 \cdot H_2O$
1% caustic soda	0.11	slight	Fe_2O_3
1% sodium dichromate	0.11	slight	Fe_2O_3, chromate
1% trisodium phosphate	0.12	none	Fe_2O_3, beta $Fe_2O_3 \cdot H_2O$
1% tetrasodium pyrophosphate	0.13	none	Fe_2O_3, beta $Fe_2O_3 \cdot H_2O$
1% soda ash	0.14	slight	Fe_2O_3
1% sodium metasilicate	0.17	slight	Fe_2O_3, beta $Fe_2O_3 \cdot H_2O$ & silicate
1% hemi-sodium phosphate	0.51	slight	Fe_2O_3, phosphate
0.01% phosphoric acid (10% neutralized)	0.65	considerable	Fe_2O_3, alpha $Fe_2O_3 \cdot H_2O$
0.01% phosphoric acid (25% neutralized)	0.20	slight	Alpha $Fe_2O_3 \cdot H_2O$ & phosphate coating
0.01% phosphoric acid (50% neutralized)	0.18	none	Phosphate coating
0.01% phosphoric acid (75% neutralized)	0.25	none	Phosphate coating
0.01% phosphoric acid (100% neutralized)	0.37	none	Phosphate coating
0.0001% phosphoric acid (75% neutralized)	0.22	slight	Phosphate coating
0.001% phosphoric acid (75% neutralized)	0.23	none	Phosphate coating

Test procedure was the water-displacement technique.

IV: COMPOSITION OF BOILER-TUBE DEPOSIT AFTER ACID-WASH

Acid-Washing		Boiler					
Draining method	After-boil solution	Mfr.*	Type	Capacity lb per hr	Press. psi	Deposit grams/sq ft	Composition
Normal	1% soda ash	BW	High head	400,000	1450	0.72	100% Fe_3O_4
Normal	1% soda ash	BW	Open pass	615,000	1485	2.0	70-80% Fe_3O_4 20-30% Cu 1-10% organic
Normal	1% soda ash	FW	2 Dm-D	150,000	425	0.27	90% Fe_3O_4 10% Fe_2O_3
Normal	1% soda ash	CE	3 Dm-bent tube	475,000	1300	0.68	90-95% Fe_3O_4 5-10% Cu
Normal	1% soda ash	CE	3 Dm-bent tube	475,000	1300	0.60	100% Fe_3O_4
Normal	0.1% phosphoric acid	BW	Open pass	450,000	1500	3.1	45-50% Fe_3O_4 30-35% phosphate coating 15% Cu 5% Fe_2O_3
Nitrogen	0.25% trisodium phosphate	BW	Open pass	450,000	1500	0.13	45-50% Fe_3O_4 30-45% Fe_2O_3 10-20% Cu
Water	1% soda ash	FW	2 Dm-D	150,000	425	0.16	100% Fe_3O_4
Water	1% soda ash	BW	Stirling	130,000	400	0.21	100% Fe_3O_4
Water	1% soda ash	BW	Stirling	350,000	400	0.24	100% Fe_3O_4
Water	1% soda ash	Wi	Cross drum	50,000	400	0.28	100% Fe_3O_4
Water	1% soda ash	FW	2 Dm-D	150,000	425	0.15	100% Fe_3O_4
Nitrogen	1% soda ash	BW	Open pass	450,000	1500	0.31	50-60% Fe_3O_4 10-20% Fe_2O_3 20-30% Cu

*BW—Babcock & Wilcox Co; CE—Combustion Engrg-Superheater Inc; Ba—J P Badenhausen & Co
FW—Foster Wheeler Corp RS—Riley Stoker Mfg Co; Co—Connelly Boiler Co; Wi—Wickes Boiler Co

is still boiler metal removed. In fact, as the phosphoric acid spends itself, still more boiler metal dissolves. Metal removed by these two causes is at least twice that dissolved by the inhibited hydrochloric washing solution.

Best method to control black-iron-oxide film is to reduce rusting of the boiler metal before the after-boil stage. One method that does this consists of displacing the acid from the boiler by means of water. This prevents any air getting in contact with the wet metal surface until the after-boil solution has been drained. (Patent pending. See Brines, ME, "Chemical De-Scaling of a Modern Steam Generator," *Power Plant Engineering*, Vol. 49, No. 7.

2—Displacing With Water. Up to date, at least 23 treatments have been made using water as the displacement fluid to remove acid from the boiler. Table V shows some typical ones. Procedure Table top of page 99 shows the correct way to use.

For our laboratory tests we immersed our 3-in.-long boiler tube section for four hours in the acid-cleaning solution. Then we introduced water. We let it flow through and around the test specimens until no acid showed. Next, the after-boil solution came in and displaced the water. We boiled this solution an hour, removed the specimen, and let it dry in the air.

Air did not come in contact with the metal surface of the specimen until the after-boil stage had been completed. Neither did any acid vapors or water vapors reach this surface as happens in the normal procedure.

These tests gave a metal surface with no visible rust film before the after-boil stage. After exposure to a boiling 1% soda-ash solution for an hour, the amount of deposit (Fe_3O_4) was 0.07 grams per sq ft. Quite some difference from the 1.66 grams per sq ft with the normal procedure.

Table III lists the results of a number of tests using water as a displacing fluid. After displacement, the metal specimen underwent an hour's exposure to various boil-out solutions at these boiler temperatures. The specimens dried out in the air and stood under atmospheric conditions for 10 days. Then the amount of after-rust was determined.

To get the necessary boiler metal protection against rusting during outage, you can use chromic acid, sodium chromate, sodium tripolyphosphate,

(*Continued on page 163*)

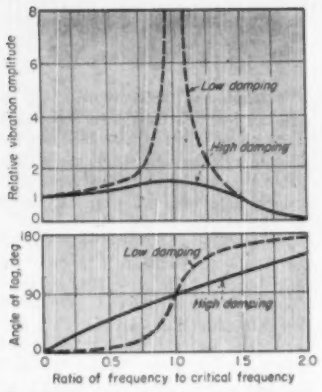
V: ACID WASH WITH WATER DISPLACEMENT

Boiler mfr*	Boiler type	Steam generated lb per hr	Operating pressure psi
Wi	3 Dm-Waterfall	150,000	400
BW	4 Dm-Stirling	200,000	——
FW	2 Dm-D type	150,000	425
FW	2 Dm-Vertical	300,000	1250
Co	4 drum	18,000	——
BW	Stirling	350,000	400
BW	Stirling	130,000	400
FW	Dual circulation	500,000	1350
RS	——	85,000	——
BW	Cross drum	500,000	1250
BW	Cyclone	400,000	1250
Ba	——	125,000	——

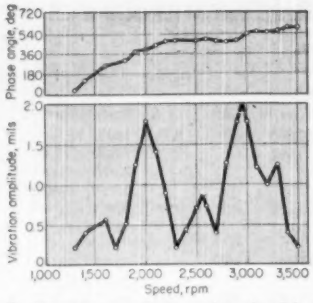
VI: ACID WASH WITH NITROGEN DISPLACEMENT

Mfr*	Type	Capacity lb per hr	Pressure psi	Cylinders of nitrogen
RS	——	90,000	140	15
BW	Single drum Radiant	450,000	925	16
BW	——	460,000	——	15
BW	Radiant	450,000	900	20
BW	Radiant	600,000	900	48
BW	Radiant	600,000	900	48
CE	VVE	1,000,000	1425	66
BW	Open pass	450,000	1500	36
BW	Open pass	450,000	1500	36

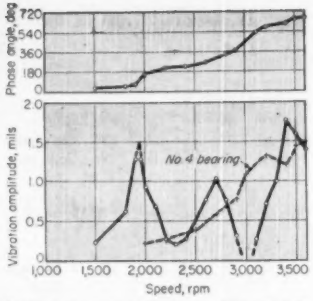
*BW—Babcock & Wilcox Co FW—Foster Wheeler Corp
Ba—J P Badenhausen & Co RS—Riley Stoker Mfg Co
Co—Connelly Boiler Co Wi—Wickes Boiler Co
CE—Combustion Engineering-Superheater, Inc



1 Vibration amplitude reaches maximum at critical frequency, 1.0. Angle of lag is always 90 deg at critical speed



2 Vibration amplitude and angle of lag vary as No. 1 turbine-generator is brought up to 3600-rpm operating speed



3 Unit No. 2 identical to No. 1, *left*, behaves differently in coming up to speed. No. 4 bearing makes unit rough

MECHANICAL VIBRATIONS
Angle and Amplitude—2

Part of a short series on practical vibration problems and their solution. This installment tells about the relation between vibration amplitude and the angle of lag between rotor high spot and heavy spot for steam turbine-generator units

By **IRA E CHURCH** *Field Balancing Service*

► IN THE MAY ISSUE, we talked about the relation between frequency and vibration amplitude. When dealing with vibration of rotating machinery, an angle of lag between rotor high spot and heavy spot must be reckoned with. The angle varies with rotor speed. High spot vibration reading usually lags the heavy spot in direction of rotation. At critical speed, angle of lag is 90 degrees, see lower part of Fig 1.

Each element of a unit with a compound shaft has its own critical speed, amplitude and angle of lag, influencing vibration readings. Both amplitude and angle depend on the amount of damping the foundation exerts. A turbine-generator, mounted on steel stringers supported by columns 20 ft long, will have low damping and large critical vibrations. A unit mounted on heavy concrete foundations has high damping with critical speed hardly noticeable. Fig. 1 shows how angle and amplitude vary with speed for high and low damping; 1.0 frequency ratio is the critical speed.

Units mounted on separate steel foundations have less influence on the building than those mounted on a common concrete slab with the building. Units mounted on concrete slabs excavated to bedrock have caused vibrations in buildings at a considerable distance.

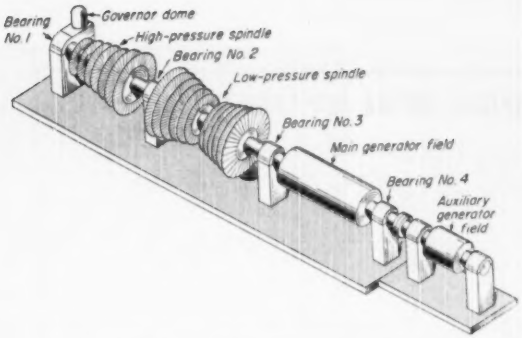
Critical Frequencies. Frequencies at critical speed must be considered when selecting points for vibration readings. If the governor dome of a turbine unit has a critical at 1800 rpm, it will have enough influence at 3600 rpm to make readings taken on the No. 1 bearing unreliable. In such a case readings should be taken on the shaft.

Two 60,000-kw units of identical design in different power plants show variations that can occur in amplitude-angle relations. Fig. 4 shows a schematic layout of the rotating elements. When coming up to speed, vibration readings were taken on each unit with the pickup mounted on the governor dome. Angle and amplitude were taken at many speeds from 1200 to 3600 rpm. Fig. 2 shows the results for Unit No. 1. Critical frequencies of all the rotor elements had an influence on the governor dome. The angle of lag traveled through almost two complete trips around the clock. Amplitude at 1300 rpm was 0.2 mil, while at 2000 and 3000 rpm it rose to 1.8 mils, but at 3500 rpm it settled back to 0.2 mil.

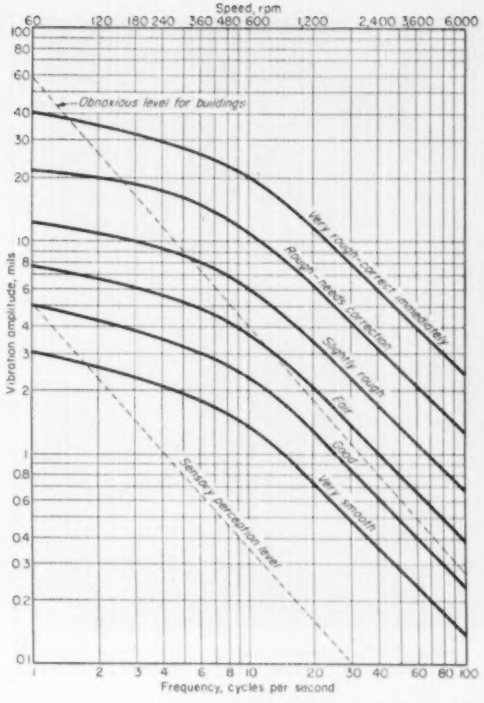
Fig. 3 shows the same information for Unit No. 2 in another plant. Here the last vibration peak comes at a higher speed, 3400 rpm. This is 95% of the running speed, or stated another way, running speed is only 106% of the critical speed. Each bearing was checked to find out which had a peak near 3400 rpm. Dotted curve shows No. 4 bearing has a maximum amplitude at 3600 rpm, steadily rising from 2000 rpm.

Vibration differences of No. 1 and 2 can be caused by slight variations in foundations and bearing alignment. The shaft extending beyond No. 4 bearing, on Unit No. 2, had a vibration of only 0.2 mil. After balancing the low-pressure spindle, all bearing vibration decreased with the exception of No. 4, which remained practically the same.

The unit was not available for further investigation and correction. Chances were that little could be done to lower the vibration very much because the bearing was running too close to its



4 Schematic sketch of identical Units 1 and 2 shows rotor elements of two turbines and two generators, six bearings. Vibrations usually differ at all bearings; should be checked



5 Vibration chart for machinery classifies amplitude and frequency according to the severity and need for correction

critical frequency at the running speed.

Vibration Tolerance. In 1939, T C Rathbone, The Fidelity and Casualty Co of N. Y., published a tolerance chart, which he has since revised as shown in Fig. 5. I have used this as a guide and found it useful and reasonable as far as bearing vibrations are concerned.

Bearing vibration is the only one apparent to an observer. Shaft vibration is generally greater and in a well-balanced unit may be about three times the bearing vibration. The bearing lateral vibration can also be more than the vertical, especially on the outboard generator bearing.

A unit running at 1800 rpm can be considered well balanced when the maximum vertical vibration is 0.5 mil, maximum lateral vibration 1.0 mil, and maximum shaft vibration 3.0 mils. There is a difference between the governor-end bearing and the coupling-end bearing of the turbine. The latter being more massive requires a greater unbalance to get the same vibration. The No. 1 bearing should have a minimum vibration of 0.5 mil, vertical, in a well-balanced set. The coupling-end bearing can logically be 0.25 mil.

According to Fig. 5, a 3600-rpm unit should have vibrations about half those of the 1800-rpm unit to be placed in the same class, such as "good." I have found this hard to realize in many cases. I believe this results from mounting several units on a common shaft. When only one turbine spindle and one generator mount on a shaft, the curve ratios can be approached. Where a high- and low-pressure spindle and a generator are on a common shaft, it is more difficult. A weight placed in any balance ring has a large influence on all other parts of the unit rotor.

This may be caused by the difficulty in keeping bearings all in vertical alignment so they carry their proper share of load. In one case a large 3600-rpm unit had been balanced before overhaul. While down, the bearings were checked and one of them raised 6 mils. After going on the line, this bearing showed a vertical vibration of 2 mils, being the same as the shaft and at the same angle. Before overhaul, this bearing had a vertical vibration of 0.2 mil with a difference of angle from the shaft of 60 deg. By removing the 6-mil shim under the bearing, all vibrations decreased to their former values.

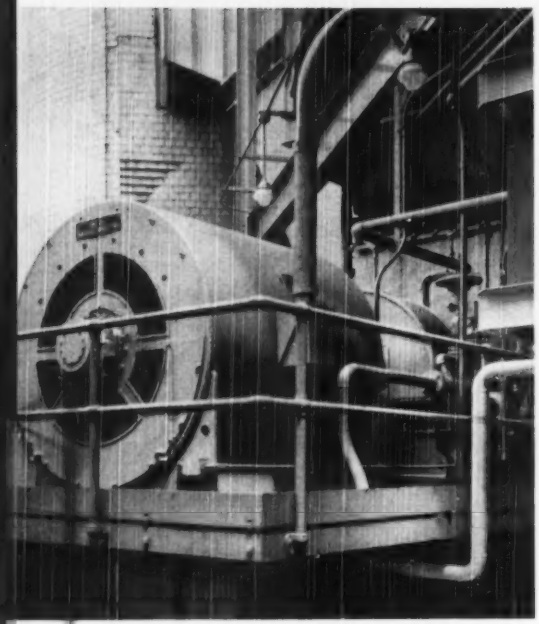
Another peculiarity of these units is the wide difference in vibration response to balance weights. In the previously mentioned 60,000-kw units, No. 1 could not be brought up to full speed until 6 oz was added to one end of the low-pressure spindle. Only 12 oz was needed to balance it. In contrast, on No. 2, 6 oz had less effect than the change in load from 30,000 to 60,000 kw, and it needed 20 oz to balance at full load.

In No. 1 the maximum shaft vibration was 1 mil, while on No. 2 it was as high as 3 mils even after balancing. Since the angle of shaft vibrations could not be changed greatly, it was assumed that the shafts must be rough or out of true, giving an error in vibration readings. Tending to confirm this was the fact that the balance weight changes did not give consistent changes in the shaft vibration and the unit had to be balanced by using bearing vibrations as calculation vectors.

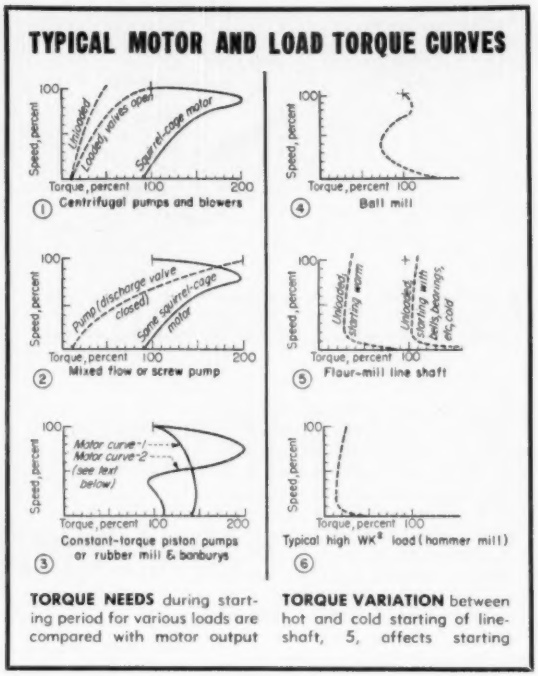
Up to now, we have talked about vibrations in a very general manner, giving some history on actual problems and their solution. In the next installments we will take a quick look at balancing instruments and then get down to cases on how to figure the magnitude and placement of balancing weights.

Editor's Note

T C Rathbone, the author of Fig. 5, states it represents results of a great number of observations on many types of machines. Curves should be regarded as the center lines of areas that extend about 25% above and below the vibration values. This should be quite obvious, in view of the manner in which the curves were derived. It probably would be better to show the chart as shaded zones because of the tendency to use curves as fixed values instead of as averages over a range of values.



INDUCED-DRAFT FAN is load on 1250-hp cage motor. Hydraulic coupling eases start, permits varying speed


TYPICAL MOTOR AND LOAD TORQUE CURVES
Speed, percent
100
Unloaded
Loaded, valves open
Squirrel-cage motor
Torque, percent 100 200
1 Centrifugal pumps and blowers
Pump (discharge valve closed)
Same squirrel-cage motor
2 Mixed flow or screw pump
Motor curve-1
Motor curve-2
(see text below)
3 Constant-torque piston pumps or rubber mill & banburys
4 Ball mill
Unloaded, starting worm
Unloaded, starting with belts, bearings, etc, cold
5 Flour-mill line shaft
Typical high WK² load (hammer mill)
6
TORQUE NEEDS during starting period for various loads are compared with motor output
TORQUE VARIATION between hot and cold starting of line-shaft, 5, affects starting

Load-Needs Dictate Motor Selection

Considering load characteristics is logical starting place for motor selection. With this keynote, author reviews some common motor starting problems including pumps, mills and line shafts. Emphasis is on the speed-torque needs of load

By C D LAWTON, *Motor-Generator Section, Allis-Chalmers Mfg Co*

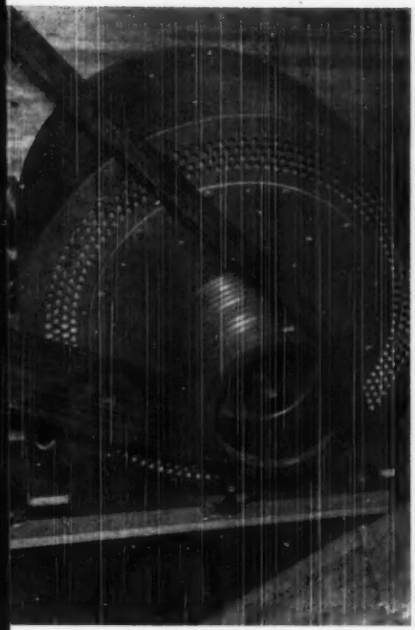
► THERE ARE TWO basic considerations in getting a motor-driven load started. First comes the speed-torque characteristic of both motor and load. On top of that, there's the load's moment of inertia or WK^2; W is weight and K is radius of gyration. Load and its WK^2 determine length of starting period. This, of course, affects motor heating. In a nutshell, starting involves the motor or *applied* speed-torque curve and *resistive* speed-torque curve of the load.

Many loads call for variable torque, others constant torque, and still others constant horsepower. Let's first consider one of the commoner type loads, variable torque, such as a centrifugal pump or blower.

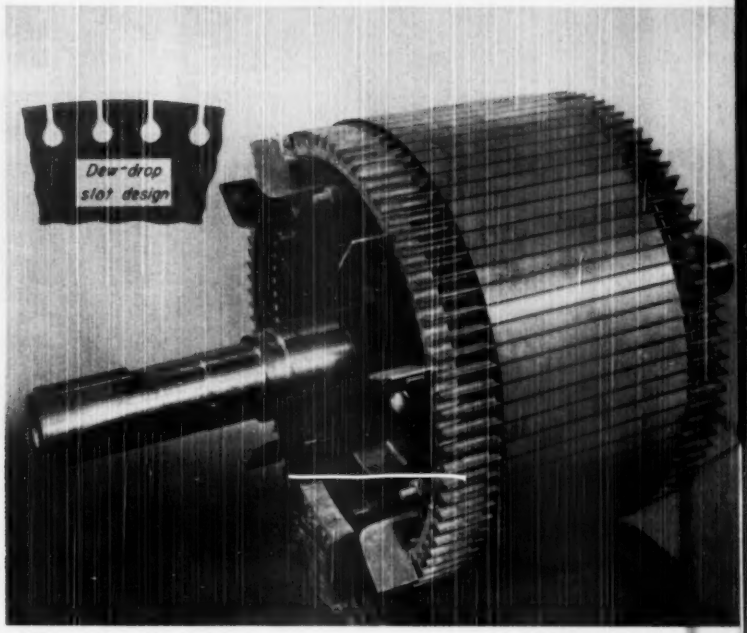
Centrifugal Pump. Centrifugal pumps and blowers require little starting torque; hence they are easy to get rolling. When started against a closed discharge valve the accelerating torque requirements are low. And centrifugal pumps don't have an appreciable WK^2. Fig. 1 is a typical speed-torque curve for a centrifugal pump or blower. Starting torque required by the load is about 10 to 15%. With closed discharge valves the load builds up smoothly with increasing speed. At full speed, the torque required is about 40% of full load. Then torque needs build up as the discharge valve opens. At full valve opening, operating torque and horsepower is normal.

On the other hand, if pump or blower is started with all valves or dampers open, speed-torque requirements follow the other curve shown in Fig. 1. Most any motor, induction, synchronous or dc, starts either load. But when starting with fully opened discharge valves, a synchronous motor must have slightly greater than 100% pull-in torque.

Since the majority of pumps and blowers are driven with squirrel-cage motors, let's analyze speed-torque curve for a cage motor. Of course, actual starting torque of a squirrel-cage motor depends on individual design and may be anywhere from 60 to 135%. We've taken 90% as an example, Fig. 1. Note the accelerating curve is smooth, reaching a maximum torque at 200%. Rated load point is reached at about 2½% slip. At this point, applied or motor torque is equal to the resistive or load torque. Motor and load operate at this speed. There is a large excess of motor torque from zero speed to full speed. Since this margin of excess torque



HIGH-STARTING TORQUE built into this 150 hp, TEFC motor for flour mill use



DEWDROP BAR design allows high starting torque along with good starting kva and efficiency. Starting torque is about 175% full load for large squirrel-cage motors

determines, to a large extent, the acceleration time, the motor accelerates rapidly.

Remember, fan drives require more horsepower and torque when starting with cold than they do with hot gases. Furthermore, certain fan drives may have a high WK^2, which serves to increase the entire starting problem. Both of these points should be checked.

Mixed-Flow Pumps. Mixed flow or screw pumps often operate with no valves in the system. Speed-torque characteristics are somewhat different from those of a centrifugal pump. Fig. 2 illustrates by a dashed line the speed-torque curve of a typical mixed-flow or screw pump. Note, in this case, pump starting torque is about 10%. And full-speed torque against a closed discharge is about 200%. In applying a motor to this drive, we could use a squirrel-cage motor with a pull-out or maximum torque greater than 200% to carry load until discharge valve opens. Valve should be opened within 15 or 20 sec to avoid overheating motor.

If there are no valves, the load and motor torque are 100% at full speed. In applying synchronous motors to these pumps this torque factor has to be considered carefully. Hence pump torque at full speed must be reduced to below motor pull-in torque. This is sometimes done by pumping air into the system before starting, or by partly opening discharge valve during starting. There are usually no WK^2 problems with this drive.

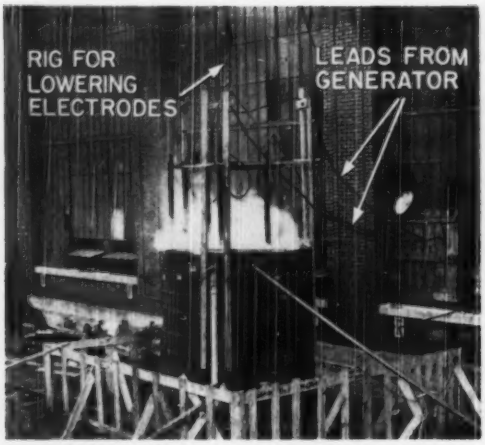
Rubber-Mill Drives. There are many constant-torque drives in industry. For instance, piston pumps, rubber mills and banbury-mixer drives. Torque curve of this type drive remains about constant over entire range from zero speed to full-load speed. Actually, torque curve may vary somewhat from the constant-torque line but, for all practical purposes, the drive is considered a constant torque. These drives are shown in Fig. 3.

Often synchronous motors are used with constant-torque drives. Reason is these are base loads in a plant and are a good place to correct low pf. But some of the older synchronous motors do not have this torque characteristic. Curve No. 2 in Fig 3 shows a case where an older synchronous motor is used without the correct discharge register. It starts and accelerates the load to about 30% speed. At that point, motor and load torque are equal. Here the motor stops accelerating and runs until it is taken off the line or fails. If it were possible to get the speed above this critical region, the drive would accelerate to full speed. But since this is not possible, such a motor should not be used with a constant-torque load. And 10% is not sufficient margin of safety for starting torque.

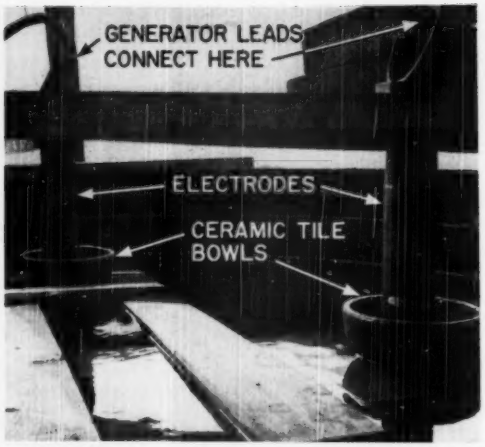
Grinding-Mill Drive. Fig. 4 shows a speed-torque curve for a typical ball mill. This curve applies in general to rod mills, tube mills, slug mills, etc. Note the starting torque is quite high, somewhat over 100%. And there is a part at about 85% full speed where torque required exceeds full-load needs. Smaller ball mills, perhaps 200 hp and less, often use wound-rotor motors or high starting-torque squirrel-cage motors. Because the larger mills represent a base load, they practically always use synchronous motors. Starting torque requirements or grinding mills are mighty high. Mill may have been shut down over the weekend and its heavy charge may have squeezed out all oil between journal and bearing leaving metal-to-metal contacts. On top of this, low Monday morning temperature means thick lube oil. Grinding mills thus represent one of the most difficult of all starting conditions.

There are various ways of producing enough starting torque. If a synchronous motor is coupled directly to the mill, it must have at least 150 to 200% starting torque. As load approaches full speed (end of acceleration period) motor pull-

(*Continued on page* 196)



WATER RHEOSTAT for load-testing 6.9-kv deisel-driven generator. Heavy arcing and water turbulence halted test until . . .



. . . **TILE PIPE** was slipped around each electrode. Smooth load regulation resulted. Tile held in position by a wooden frame

Tile Pipe Helps Generator Load-Test

By E C LAWRENCE, *Electrical Test Engineer, Kaiser Steel Corp, Fontana, Calif.*

► STANDARD CERAMIC-TILE PIPE proved the unusual solution to an arc-over problem met while load-testing a 1420-kva 6900-v 3-phase generator. Specifications required unit be tested with its diesel-engine prime mover over the entire operating range including overspeed.

Problem. Wooden-vat water rheostat, about 8 ft in diameter and 10 ft high, was used for field tests of the 2400-v generators. We changed the delta electrode spacing from the original 22 in. for the 2400-v generators to 46 in. apart for this 6900-v unit. Water level was held at 9 ft.

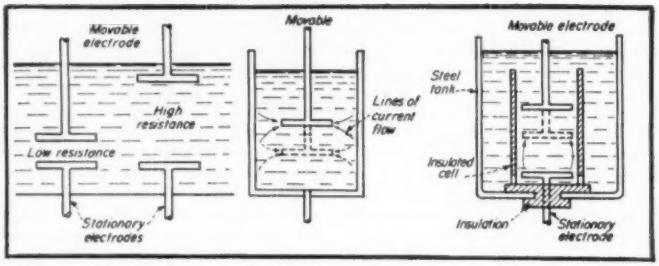
Generator test voltage was first adjusted to about 5000 v. Water-rheostat electrodes were lowered slowly until water contact was made. Heavy arcing of foot-long flames and general water upheaval resulted. This threw an excessive overload on the generator.

Voltage was reduced to 3500. And then we got full load with one inch of electrode immersion. But arcing and water "boiling" continued. Changing electrode diameter, delta spacing, as well as several changes of water made no difference. Then we realized a phase-sectionalizing compartment in the water rheostat was necessary. Aim was to get higher resistance paths that would give a vernier loading control.

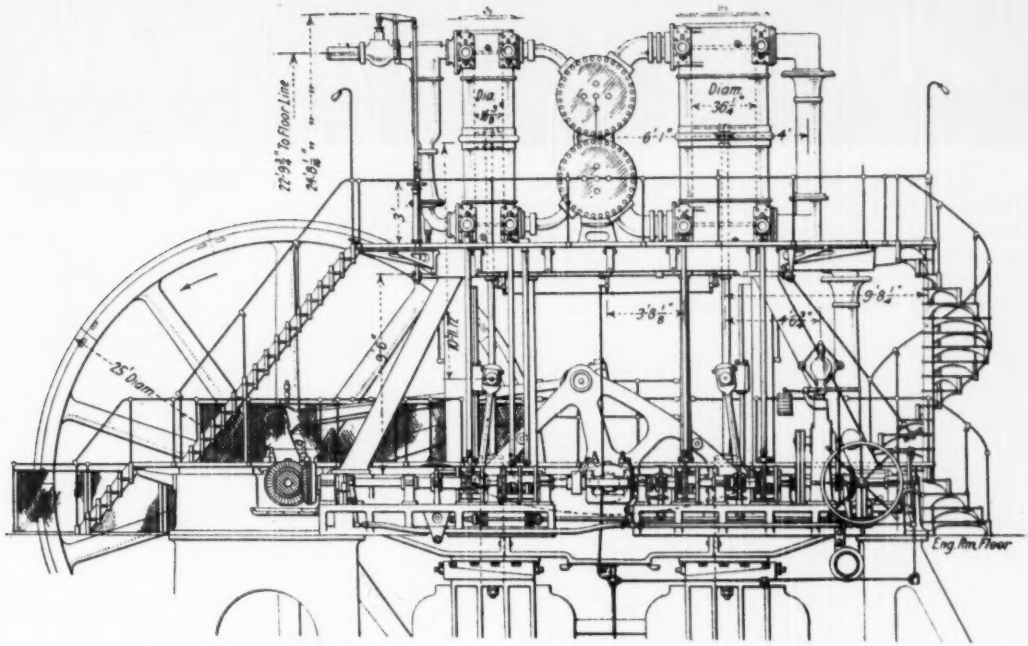
Solution. Best bet appeared to be regular 6-in.-ID tile pipe about 27 in. long beyond the bowl. A wooden frame was made to support the pipe (top right). We tried using one tile-pipe section for each electrode and a delta spacing of 43 in. This setup allowed dunking the electrodes a depth of 2 ft for full load. The drawback was too-critical adjustment and fast loading as electrodes approached bottom of each phase tile pipe. Second length of tile pipe per phase was added. Once again support was a wooden T frame.

With two sections of tile pipe for each electrode, we got good loading regulation. Vernier adjustment could be had for a total immersion of 50 in., which represented full load. Maximum water level was held a scant ⅛ in. over top of tile pipe. This allowed water circulation and prevented excessive loading. It is interesting to compare electrode immersions. We could drop to 50 in. within tile pipe for the 6900-v generator in contrast to a 36-in immersion without tile pipe for 2400-v unit. Both generators had an equal kva. Of course a 22-in. delta electrode spacing was used with the 2400-v unit.

Here's a Comparable Problem



LIQUID RHEOSTATS had comparable problem. Only here it was a question of current leakage to steel tank. Answer was to place stationary electrode in insulated cell



COMPOUND PUMPING ENGINES designed more than 50 years ago by the late E D Leavitt. Rated 10 mgd each (two engines). Steam cylinders are 16⅜ in. and 36¼ in., with pump plungers 13 7/16 in. and 19⅜ in. Stroke is 7 ft, 6 in.

Pump Veterans Retire After 50 Years

► UNTIL RECENTLY, you could have walked into the pumping plant outside the old whaling port of New Bedford, Mass. and been carried back 50 years. For there, changed but little by time, was a monument to an older kind of engineering—different but worthy.

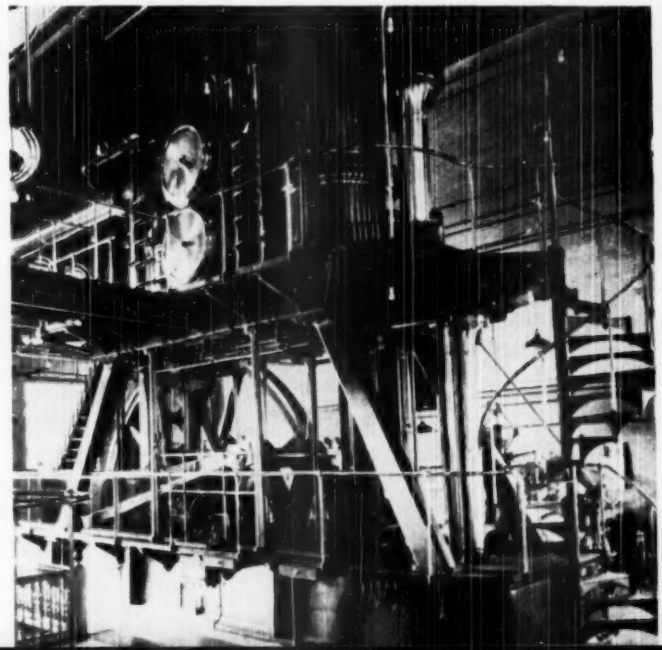
You'd have seen in the sunlit engine room two massive inverted-walking-beam engines, calmly and faithfully pumping up to 10 mgd, just as they had since 1899. You'd have seen some things that seem quaint now: Cylinders and main-steam lines lagged with walnut strips, neatly tongue-and-grooved with shining bands. Old-fashioned gooseneck standards for early carbon lamps. A near cousin to Edison's bipolar dynamo, still ready to roll.

But these would have interested you for only a moment. One thing would have caught your eye and held it—the solid craftsmanship of those designers and builders of the past. And you'd have thought how things were then.

The entire plant—engines, boilers, auxiliaries, building—was designed by one man. He was the late E D Leavitt, one of America's great mechanical engineers. Educated in the public schools

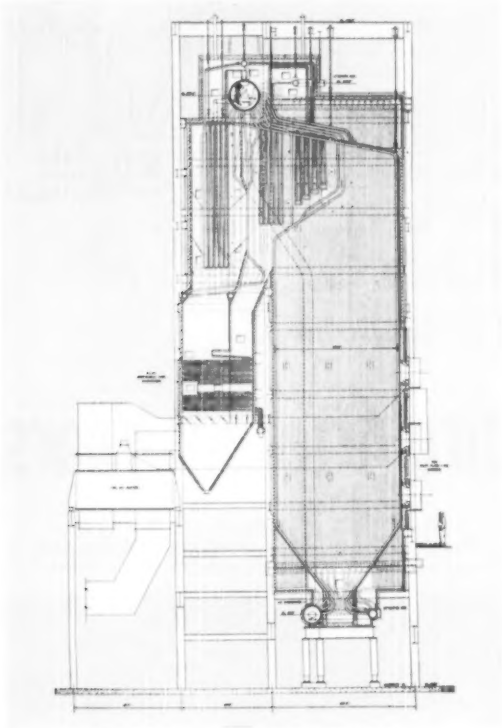
CONTINUED ON PAGE 110

PRECISE BEAUTY of fine machinery is evident in every line of this grand old engine, which still pumped faithfully at the end of almost 50 years' steady service



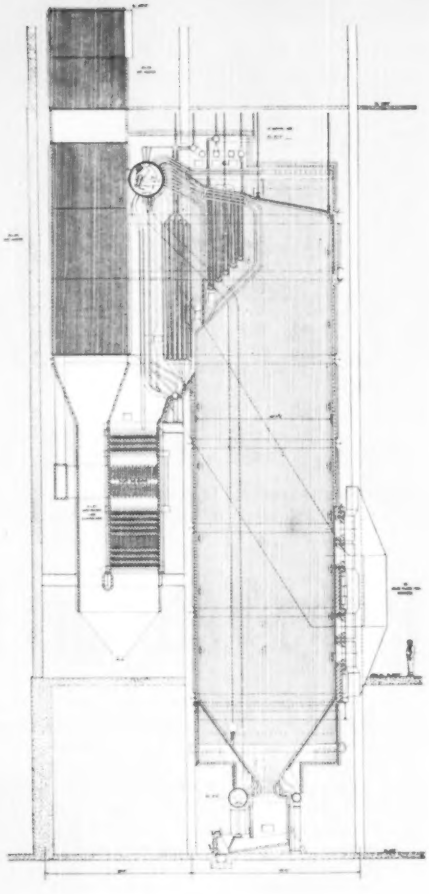
all across the country, Public

THERE is a very noticeable swing among Public Utilities to Riley Steam Generating Equipment. More and more Public Utility Companies are making their initial installation of Riley equipment and those companies who have tried Riley equipment are, almost invariably, coming back for more Riley units when expanding capacity.



JORDAN STATION, Utah Power & Light Co.
620,000 lbs./hr. 1500 lbs. 955°F. Riley Unit
Bechtel Corporation, Consulting Engineers

Utah Power & Light Co. has also installed a 400,000 lbs./hr. Riley unit at their Orem Station and are installing a 60,000 lbs./hr. unit at Western Colorado Power Co.



R. S. WALLACE STATION, Central Illinois Light Co.
600,000 lbs./hr. 950 lbs. 910°F. Riley Unit

This is the fifth Riley unit to be installed at this station. Four 300,000 lbs. hr. Riley units have been previously installed.

TRADE MARKS Rx REGISTERED

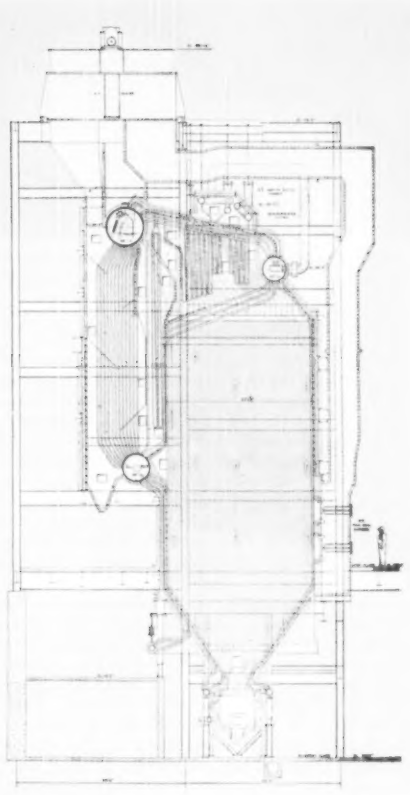
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
Cincinnati · Atlanta · New Orleans · Memphis · St. Louis · Kansas City · St. Paul · Tulsa · Houston
Denver · Salt Lake City · Los Angeles · Portland · Seattle

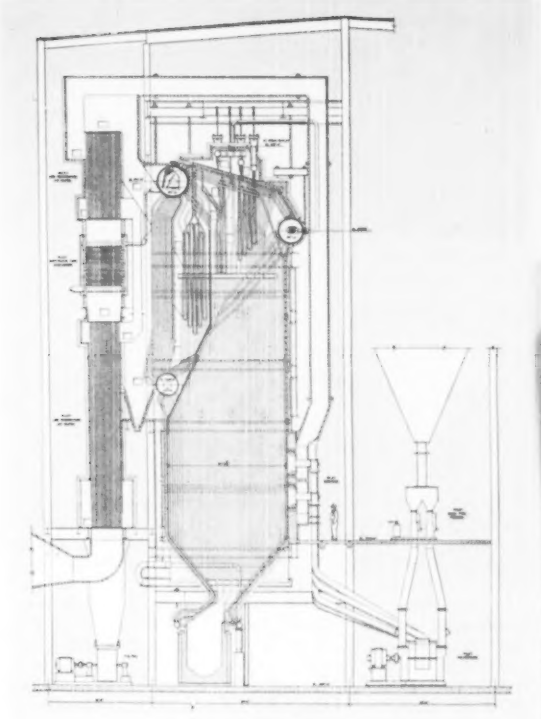
BOILERS · PULVERIZERS · BURNERS · STOKERS · SUPERHEATERS · FLUE GAS SCRUBBERS

Utilities are SWINGING to Riley Units



EDWARDSPORT STATION, Public Service Co. of Ind.
400,000 lbs./hr. 1000 lbs. 910°F. Riley Unit
Sargent & Lundy, Consulting Engineers

Public Service Co. of Indiana has installed Riley units at Dresser and Noblesville stations also—six Riley units, total capacity 2,000,000 lbs. of steam per hour. An additional unit is on order for the Edwardsport station.



RIVERTON STATION, Northern Virginia Power Co.
350,000 lbs./hr. 1100 lbs. 900°F. Riley Unit
Sanderson and Porter, Consulting Engineers

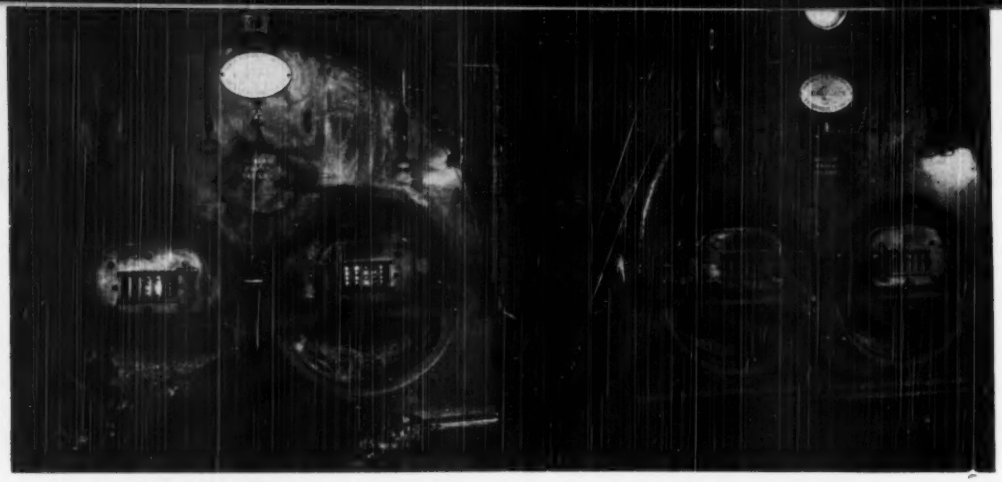
You Can Rely on Riley

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS · WATER-COOLED FURNACES · STEEL-CLAD INSULATED SETTINGS · AIR HEATERS



CYLINDRICAL FIRETUBE BOILERS, almost 30 ft long, have a service record to be proud of, too. Never forced, carefully handled, they supplied steam to the pumping engines for half a century. Original charcoal-iron tubes weren't out for 46 yr

CONTINUED FROM PAGE 107

of Lowell, Mass., he learned his profession in the shops and drafting offices of New England. After Navy service in the Civil War, he began private engineering practice in 1867.

Not long after, he designed pumping engines for Lynn, Mass. These were far ahead of the times in economy. Leavitt became known. Other cities—Lawrence, Boston, Cambridge, Louisville—engaged him, as did many large mining and industrial companies.

In the course of designing these then-famous engines, Leavitt made many improvements in practice. He was partial to the inverted walking beam, which made a long, low, stable engine. He used this feature when engaged for the New Bedford design.

You can still see the beautiful set of drawings—some hundred of them—he made for this plant. And Howard Mandell, superintendent of the water department, will show you Leavitt's bill for his design—$12,000. The two engines, built by Dickson Mfg Co, Scranton, Pa., cost $125,000. The boilers cost $8000 each: One was built by I P Morris Co of Philadelphia, the other by Atlantic Works of Boston.

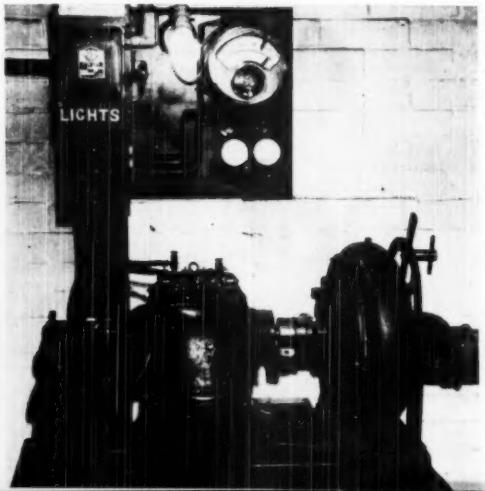
Testimony to soundness of design and construction lies in the record. The plant has served New Bedford 50 years. During the last half of this service it was supplemented by a 5-mgd centrifugal pump, a B&W watertube boiler and a 25-kw Ames engine-generator. The pumping engines saw essentially continuous service. The low-pressure steam cylinder of one engine was rebored after about 35 years. Pump water valves were renewed but once.

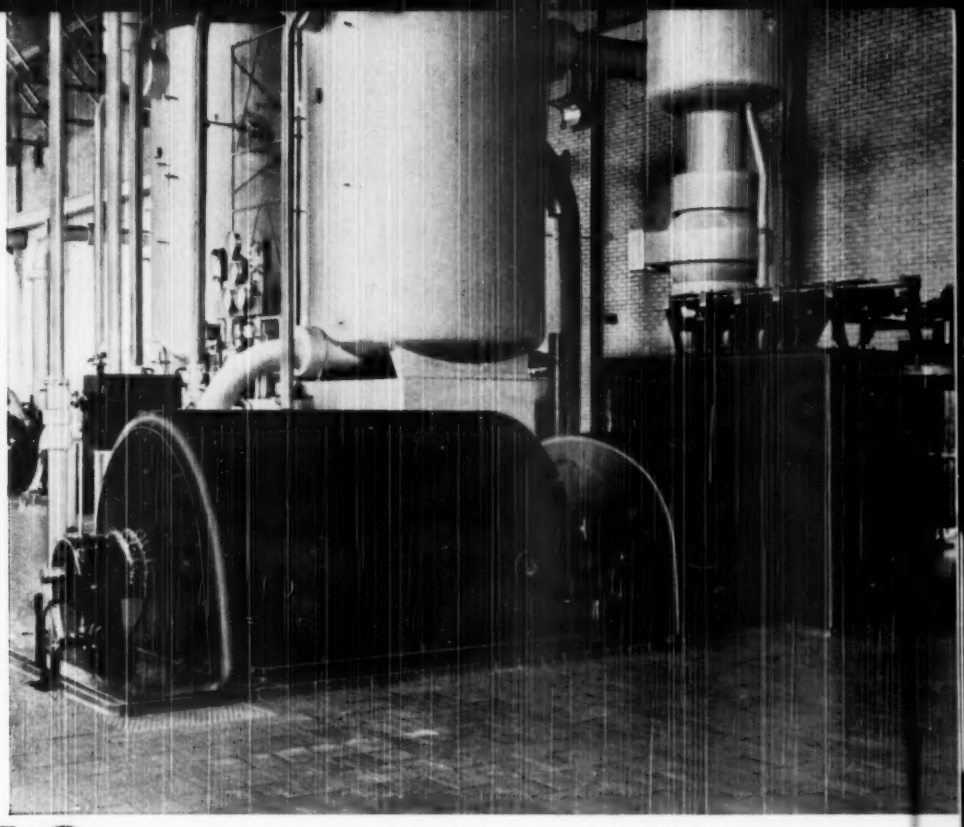
In the boiler room, pressure was reduced on advice of the insurer—from original 185 to 163 psi after 40 years, and then to 145 psi last year. But boilers still saw daily service. Original charcoal-iron tubes lasted until 1946.

All this was true some months ago. If you should go to the plant now, things would look very different. And you'd be aware of another contrast between today's engineering and yesterday's. Leavitt's sturdy stone building still stands but its engine room is empty. In the basement stand motor-driven centrifugal pumps having more than twice the capacity of the old engines. (One at 15 mgd, three at 10 mgd—all pumps are DeLaval, driven by Electric Machinery motors.) A standby pump, driven by a 6-cyl Baldwin diesel, can handle 15 to 30 mgd.

PROUD OPERATORS gather by valve gear of No. 1 engine for "auld lang syne." At the rear right is George F Burgess, chief engineer. Next to him is H C Mandell, supt, water department

HYDRO POWER. This generator set, driven by water from the system, supplied lighting for original plant. Built by Belknap Motor Co, it carries serial No. 213, is rated at "25 lights"





Used 18 years, oil goes right back on the job

● In 18 years of operation, the original fill of NONPAREIL Turbine Oil was never removed from this 2500-KW turbine at the University of Michigan power house. Neutralization numbers always stayed below 0.07 mg. KOH/gm. Tests of oil samples showed no deterioration of the lubricant.

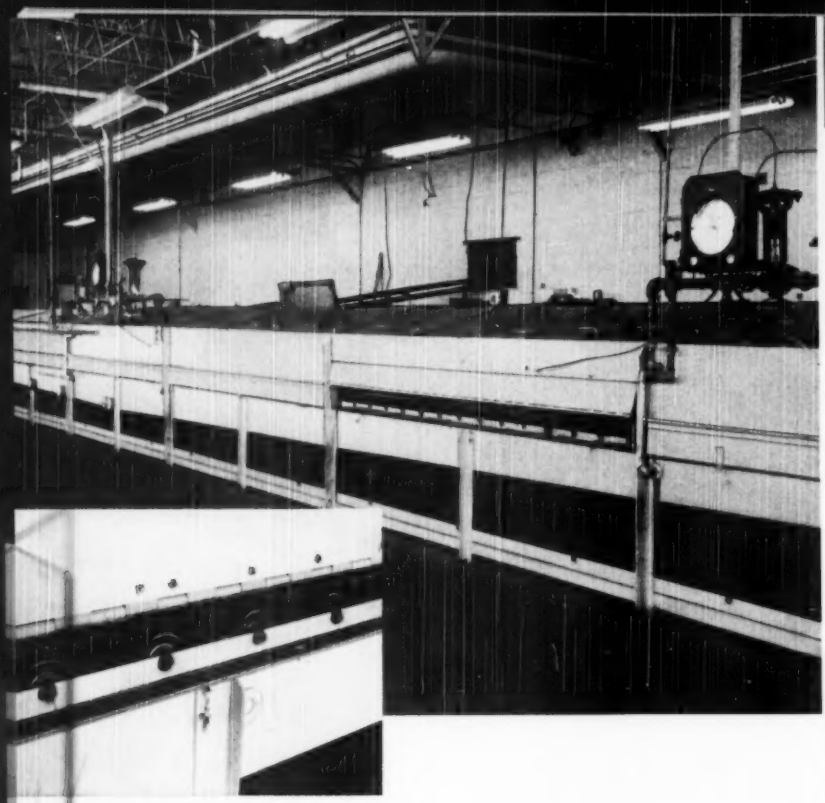
Recently, the turbine was shut down for inspection and general overhaul. Operators drained NONPAREIL from the unit and took a close look at the oil system. *They found no oil deposits, no evidence of rust, and not a sign of corrosion.* The oil itself was in excellent condition and after centrifuging it was returned to the turbine for continued use.

You, too, can obtain such lubrication advantages. By switching to NONPAREIL Turbine Oil, you can eliminate oil acidity troubles and oil system maintenance once and for all. These benefits are not only indicated by the experience of others but are backed by the written guarantee you receive that NONPAREIL will last as long as the turbine and that its acidity will stay below 0.15 mg. KOH/gm.

A Standard Oil lubrication specialist will be glad to supply you with actual case histories of utility operations on which Nonpareil Turbine Oil has reduced lubrication costs as much as 68%. To arrange for his visit, write: Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago 80, Ill.

NONPAREIL
Turbine Oil

STANDARD OIL COMPANY (INDIANA) STANDARD



Bearings lubricated not once a day but once in two weeks

CONVEYOR ROLLS on the pasteurizer (above) are continually subjected to water spray at temperatures ranging from 60°F. to 212°F. Under such conditions it is usually extremely difficult to lubricate the roll bearings.

When this unit was installed, it was expected that rolls would have to be lubricated daily—a large order on a conveyor 80 feet long with rolls spaced 6 inches apart. However, a Standard Oil lubrication specialist was asked for his recommendation. He selected STANOLITH Grease—a lithium-soap product with the ability to withstand both heat and water.

The conveyor, now operating on STANOLITH, is lubricated—not daily—but *once every two weeks*. STANOLITH provides good lubrication at both high and low temperatures in the machine and is not washed away by the spray.

Lubrication problems caused by heat, water, or low temperatures in your plant can be solved by this one lubricant: STANOLITH Grease. Through its remarkable versatility, you can avoid the cost and trouble of stocking and using a variety of special greases. A Standard Oil Lubrication Engineer will help you make these savings. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANOLITH
TRADE MARK
Greases

What's YOUR problem?

Mr. J. D. Clark of Standard Oil's Saginaw, Michigan, office is the lubrication specialist who helped this customer make a worthwhile saving by recommending STANOLITH Grease.

Standard's lubrication specialists are located throughout the Midwest. One of them is within easy reach of your plant. He offers you an on-the-spot lubrication service that's backed by extensive experience and training in the use of modern lubricants and fuels. He can help you make important reductions in operating and maintenance costs.

Arrange, today, for a visit of this lubrication specialist by phoning or writing the nearest Standard Oil Company (Indiana) office. Ask him to give you actual performance data on these outstanding products:

STANOIL Industrial Oils—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

SUPERLA Greases—Available in a wide range of consistency grades and in both lime-soap and soda-soap types, SUPERLA Greases cover a wide range of operations. These efficient products are comparable in quality with the highest type of special greases.

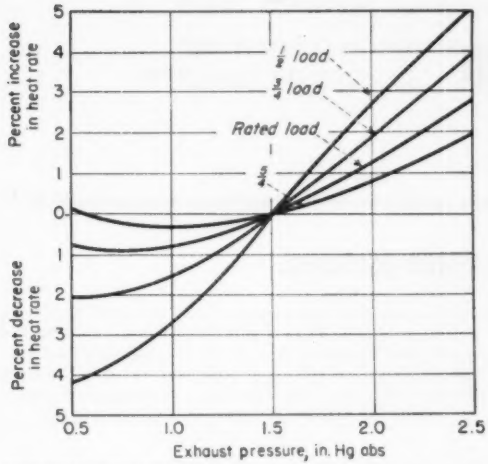
CALUMET Viscous Lubricants—On open gears and wire rope, these greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of gears, better internal lubrication of wire rope.

STANORUST Rust Preventives—The eight grades of STANORUSTS form one of the most complete and effective lines of rust preventives on the market today. Each has been scientifically and specifically developed for its intended use. The grades range from a fingerprint remover to a heavy petrolatum that protects against corrosion for years under the most severe outdoor exposure.

STANDARD **STANDARD OIL COMPANY (INDIANA)**

LETTERS FROM A TURBINE SPECIALIST—12

By C A LILLY JR and J E DOWNS, *Turbine Divisions, General Electric Co*



DROPPING EXHAUST PRESSURE too low at high loads causes excessive pressure drops to overbalance higher availability

TOO LOW AN EXHAUST PRESSURE MAY MEAN A POOR HEAT RATE

Dear Mr Specialist

Every winter when our circulating water is very cold, we recirculate to keep the exhaust pressure at about 1 in. Hg abs. Although I know this practice gives a better heat rate than not recirculating, I'm not sure of all the reasons why a lower exhaust pressure causes a loss in efficiency.

I would appreciate your letting me know what this is all about. Please give me some guide as to the exhaust pressure that will give the best heat rate.

Yours very truly
ENGINEER

Dear Mr Engineer

From the heat rate standpoint, we usually want a low exhaust pressure for a steam turbine. As we often find in other situations, however, we can get too much of a good thing. Occasionally over-all power-plant heat rates increase because of too low a backpressure.

We are all familiar with the fact that as the exhaust pressure on a turbine decreases the energy available to the turbine increases. This converts more Btu's into mechanical energy. The amount of this additional energy that a turbine can absorb finds a limit in the "choke" in the exhaust flow.

When the volume flow of steam reaches the velocity of sound while passing through the last-stage bucket annulus, further decrease in exhaust pressure raises the pressure drop through the exhaust hood. Furthermore, the turbine rotor does not absorb any additional energy. We call this condition "choke" in the exhaust. Meanwhile, the decreased exhaust pressure caused by the colder circulating water drops the condensate temperature in the hotwell.

This results in rejecting more heat to the condenser cooling water with no corresponding increase in energy absorbed by the turbine rotor. This all adds up to a higher heat rate. Of course, at higher exhaust pressures where "choke" does not exist, a reduction in exhaust pressure decreases the heat rate because the turbine can absorb more energy.

The graph above gives typical heat-rate correction curves for varying exhaust pressures. You will note that with the higher loads the curves flatten out and even go up, indicating a poorer heat rate as the exhaust pressure approaches 0.5 in. Hg abs.

The exhaust pressure giving the lowest heat rate corresponds approximately to the point where sonic velocity appears in the last-stage bucket annulus. This can be estimated from the formula:

$$\text{Optimum exhaust pressure} = \frac{\text{Flow to condenser}}{7600 \times \text{annulus area}}$$

where: Optimum exhaust pressure is in in. Hg abs.
Flow to condenser is in lb per hr.
Annulus area is in sq ft. and

$$\text{Annulus area} = \text{pitch dia} \times \text{bucket length} \times \pi \times \text{number of last stages}$$

Example: Correction curves above apply to a 40,000-kw tandem-compound double-flow steam turbine with 16½-in.-long last-stage buckets on a 58-in. pitch dia. Flow to condenser is 312,000 lb per hr at 5/4 load; find the optimum exhaust pressure.

$$\text{Annulus area} = (58/12)\,(16.5/12)\,\pi 2 = 41.8 \text{ sq ft}$$

At 50,000-kw load:

$$\text{Optimum exhaust pressure} = \frac{312{,}000}{7600 \times 41.8} = 0.98 \text{ in. Hg abs}$$

Examination of the formula shows the optimum exhaust pressure varies directly with steam flow to condenser or almost directly with load.

If cold circulating water in the winter gives an exhaust pressure lower than the value given by the formula, the heat rate can be improved by recirculating the cooling water to maintain optimum exhaust pressure. If two circulating pumps are used, it may prove advisable to shut down one provided the exhaust pressure does not rise too much above the optimum level.

Note, particularly, that the improvement in heat rate we are aiming at cannot be realized by bleeding air into the condenser to raise the exhaust pressure.

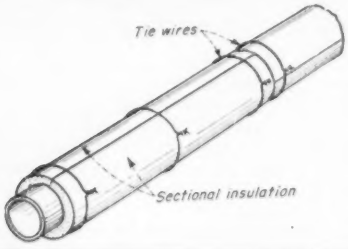
If you want any additional information, I will be glad to discuss the subject with you during my next visit to your plant.

Yours truly
TURBINE SPECIALIST

Insulation Handbook: Part 4

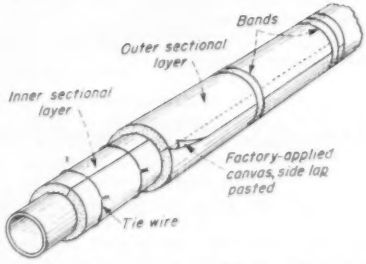
How to Apply 85% Magnesia Heat Insulation

By PHIL SWAIN, EDITOR



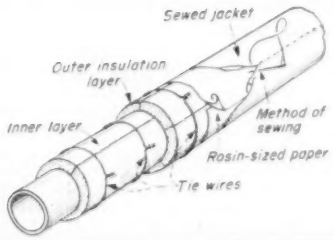
WIRED SECTIONAL

Here factory canvas is removed. Use at least 3 annealed iron wires per section. Twist wire ends together, bend over and press into insulation for protection. Stagger lengthwise joints. Point up all joints with 85% magnesia cement. An alternate method omits wiring, pastes down laps on factory canvas and applies metal bands



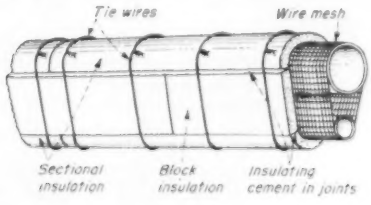
DOUBLE LAYER

Handle inner layer as before. Apply outer layer with all joints staggered. Outer layer may be wired without canvas like inner layer, or may be finished by pasting down factory canvas and banding



SEWED CANVAS JACKET

If cost of better looking, more durable job is warranted, remove factory canvas. Apply layers as above, followed by rosin-sized or sheathing paper. Stretch 8-oz canvas over paper, sew in place, coat with glue sizing, paint as desired. To avoid scorching canvas finish by heat from nearby flanges or other uninsulated surfaces, stop canvas and paper a few inches short of insulation end. Finish exposed ends with asbestos cement



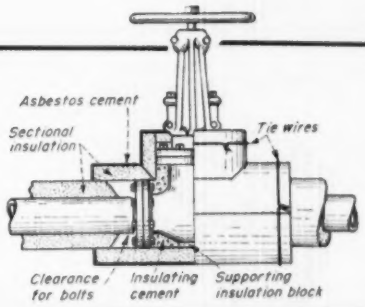
PARALLEL PIPING

Where two parallel pipes are too close for convenient separate insulation, or where a steam pipe must protect a water pipe from freezing, or keep oil line warm, arrangement pictured is convenient and practical

Practical know-how in convenient form. Drawings and condensed instructions summarize standard procedures in the 85% *Magnesia Insulation Manual*, published by the Magnesia Insulation Manufacturers' Association, of Washington, D. C.

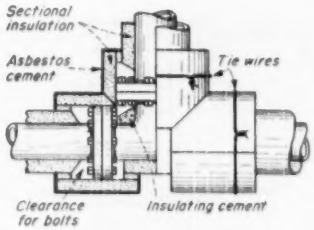
LARGE VALVES

To insulate valves of 4-inch pipe size or larger, build cover of block or sectional insulation of any convenient shape. Tie together with wires. Seal crevices with insulating cement. Use solid insulation half-inch thinner than pipe insulation to allow for cement finish. Then build to full thickness with asbestos cement, 2 coats.



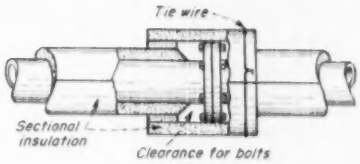
LARGE FITTINGS

Treat fittings, 4-inch and up, same as valves. Note: For valves and fittings under 4-inch, cover directly with asbestos cement in several half-inch layers to bring total thickness up to that of pipe covering. Allow each coat to dry before applying the next



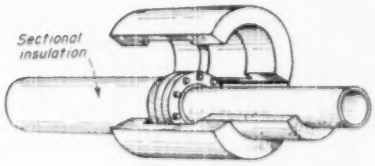
PERMANENT FLANGE INSULATION

Wire sectional insulation or blocks firmly in place and cover with asbestos cement. Extend flange insulation at least 2 inches over adjacent pipe insulation. Fill open space (in overlap) with insulating material. Cut back and bevel pipe insulation to allow removing bolts

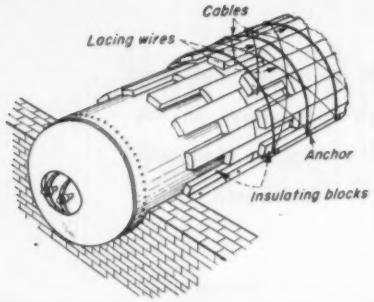


REPLACEABLE FLANGE INSULATION

Design pictured can be removed and replaced. Wrap sectional insulation with wire mesh and finish with asbestos cement. Or build wire mesh in two halves, cover with blocks. Cover this with wire mesh and cement inside and out

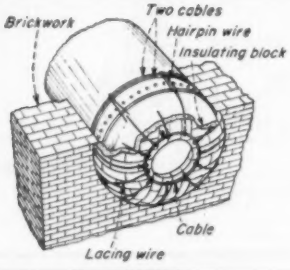


For more insulation facts, turn page→



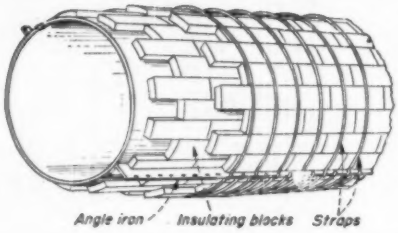
STEEL DRUMS

Where full circumference is not exposed, as with boiler drums, install firm anchorages. Fit blocks to cylinder, staggering joints, and bind firmly with annealed iron wire laced through steel straps or wire cables



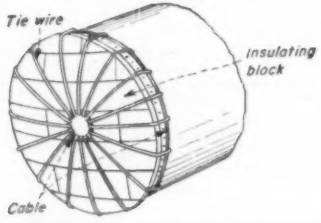
DRUM HEAD

Secure job requires anchoring blocks in manner shown, or equivalent. Since curved blocks are not available to fit round end of tank, pieces of flat block are used. These are held in place by network of wires. Finish with asbestos cement in one or several layers.



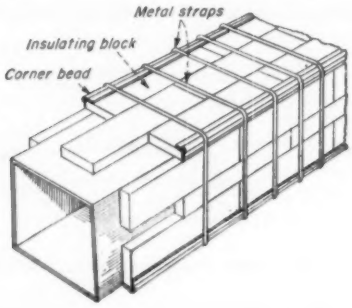
HORIZONTAL TANK

Horizontal tank pictured is completely encircled by insulation. Note that insulation in lower half tends to sag from tank, so must be more firmly held in place. Angle irons shown are one way. Asbestos cement finish



HORIZONTAL TANK END

Anchoring method, much like that for boiler-drum end but with more gradual curve, may allow use of full-size blocks. Asbestos cement finish

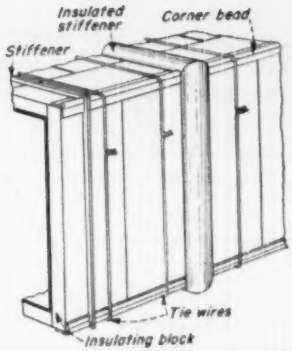


DUCTS WITHOUT STIFFENERS

Case pictured: breeching, duct or flue with no stiffeners or other projections. Nor is any provision needed for expansion. Blocks applied directly to surface and held by wire cables or metal straps. Metal beads protect corners

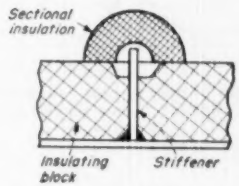
DUCT SURFACE WITH STIFFENERS

When projections are far apart and there's no need to allow for expansion and contraction, wire blocks directly to surface and insulate stiffeners as pictured below



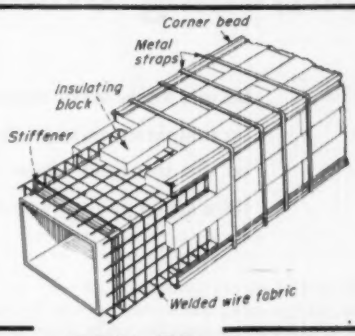
STIFFENER INSULATION

Half sections may be used to insulate stiffeners or other projections on ducts, shown above



DUCTS WITH PROJECTIONS

Where stiffeners or other projections are closely spaced, or where you must allow for expansion or contraction, stretch heavy-iron-wire fabric over the projections to form a foundation. Then wire blocks in place and finish with asbestos cement in the usual manner



Facts to Remember About 85% Magnesia

► As the name suggests, 85% magnesia contains not less than 85% of magnesium carbonate. To this white, crystalline, extremely light insulating material, the makers add 15% of asbestos fiber as a binder.

The wet mixture of magnesium carbonate and asbestos fibers is shaped first by molding and drying, then (usually) by machining to commercial dimensions. Usual commercial shapes are split shells—called sectional insulation—for piping, flat blocks, also curved blocks—segmental insulation—to fit large piping and tanks.

The K Factor

In a recent test of a commercial block of 85% magnesia, the U.S. Bureau of Standards measured the density as 13.2 lb per cu ft. The K value (Btu transmitted per hr per sq ft for a temperature gradient of 1 deg F per inch of thickness) was 0.39 at 130 F mean temperature. This compares with MIMA values of 0.39 at 100 F mean temperature, 0.45 at 300 F, and 0.51 at 500 F.

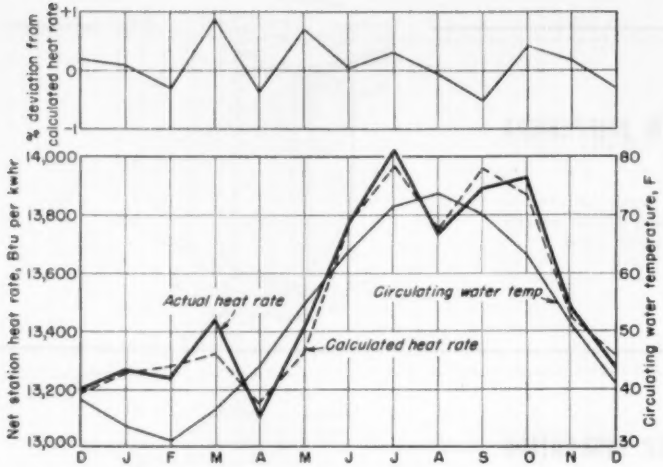
85% magnesia insulation withstands temperatures up to 600 F without damage. Above 600 F the material begins to calcine. It withstands repeated wetting and drying.

For heated surfaces operating above 600 F, an 85% magnesium outer layer is customarily applied over an inner layer of high temperature insulation—usually "diatomaceous silica," molded with a binding component of asbestos fiber.

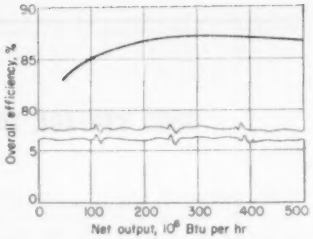
Commercial thicknesses of sectional insulation and blocks include 1½, 2, 2½, and 3 in. Sectional insulation is also available in graded sizes known as "standard" and "double standard." See table below:

Insulation Thickness: Standard (S) And Double Standard (DS)

Pipe size, nominal	*S*	*DS*
½ to 1-½	7/8	1-29/32
2 to 3-½	1-1/32	2-5/32
4	1-⅛	2-¼
5 & 6	1-⅛	2-5/16
8 & 10	1-¼	2-½
12 and over	1-½	3



1 Major changes in monthly heat rate tend to follow cooling-temperature variations. Proper analysis figures actual heat rate to within less than 1 percent



2 Modern steam generator's efficiency stays fairly constant over load range

By B G A SKROTZKI
Associate Editor

Controlling Steam-Station Efficiency: 1

Do you know what causes your monthly station heat rate to go up and down through the year? Conditions that you think may be the principal cause are probably only partly responsible. Here's how you can can make a complete analysis of heat rates*

► FOR MINUTE-TO-MINUTE OPERATION, adequate guides are steam-flow air-flow ratio, temperature of exit flue gas, and turbine-stage pressure vs load. But while these factors tell the operator the status of individual equipment, they do not give a true indication of how well the *entire* station is doing at any given moment.

Weekly and monthly heat rates are still the final measure of station performance. Since many factors affect this figure there is always uncertainty about whether the result is good or bad. For exact effect of each operating factor on the heat rate we need a rigid analysis. Spot calculations never are satisfactory because they usually overlook the multitude of factors involved and concentrate on the few *thought* to be responsible.

When I was working for a large metropolitan station with 8 turbine-generators and 32 stoker-fired boilers, I carried on such a form of rigid analysis. Complete test performance data were available for each item of major equipment. These data and their analysis form the basis of an efficiency control. (1) They tell operators definitely whether equipment performs satisfactorily, even with seemingly adverse results. (2) They show clearly what factors cause unexpected variations in performance.

First part of the analysis figures the expected performance for comparison with actual. Close agreement indicates satisfactory condition of equipment. Actual heat rate higher than expected (calculated) indicates maladjustment somewhere in the station cycle. Actual rate lower than expected indicates computing error in either heat rate.

Fig. 1 shows monthly heat rates for 13 months of the station mentioned. Actual heat rate followed, broadly, the general trend of cooling-water temperature. There were unexpected dips and rises as for March, April, July, August. But calculated heat rates follow the actual closely. Deviation diagram above shows actual heat rate was always within less than $\pm$ 1% of calculated value. Deviations in this range are well within accuracy of all data.

How to Calculate. We must have performance data on each boiler and turbine, Fig. 2, 3, 4, 5. Fig. 3 shows how an individual turbine's heat rate varies with load and exhaust pressure while throttle pressure and temperature remain constant. Fig. 4 has similar data for variable throttle pressure and constant throttle temperature and exhaust pressure. Fig. 5 gives variations caused by changing throttle temperature, other factors remaining constant. Fig. 2 shows the flat efficiency-load curve characteristic of the modern steam generator.

Armed with these basic data, let's set up calculations for

* First part of paper presented before AIEE First National Power Conference, Pittsburgh, Pa., April 19, 1950. Part 2 will appear next month.

each turbine, Table I, p 118. Data in columns 2, 3, 5, 8, 9 are collected from the plant's log sheets, originally entered hourly or half hourly. Data are classified and averaged for each load level in col 2. Assume the table covers a month's operation. Col 4 = col 2 x 3. Total of this column should roughly equal total metered mwhr listed below. The same applies to number of hours in service. The "standard" heat rate for each load comes from Fig. 3 picked off to correspond to average backpressure in col 5. Col 7 = col 4 x col 6. This input corresponds to standard throttle steam conditions. This must be corrected to actual steam conditions in col 8 and 9. Let's run through the figuring for the 10-mw load to find how the correction factor in col 10 is computed. From Fig. 4 read heat rate at 1.0-in. back-pressure and 800 psia equals 11,610 Btu per kwhr; at 840 psia it equals 11,800 Btu per kwhr; or 40-psi pressure increase raises heat rate 190 Btu per kwhr at 10-mw load. Actual throttle pressure is 810 psia. Then heat-rate increase for 10-psi increase is (10/40) 190 = 48 Btu per kwhr at 10 mw.

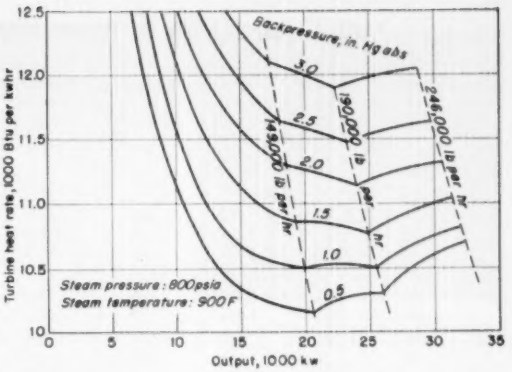
From Fig. 5, at 10-mw load read heat rate at 1.0-in. back-pressure and 900 F equals 11,610 Btu per kwhr; at 875 F it's 11,740 Btu. The 25-F drop raises heat rate by 130 Btu. Actual throttle temperature is 885 F. For the 15-F drop, heat rate increases (15/25) 130 = 78 Btu per kwhr.

Total heat-rate change for actual conditions = 48 + 78 = 126 Btu per kwhr. or 126/11,610 = 0.011. Correction factor to apply to standard heat rate in col 6 is then 1.011 as in col 10. Corrected heat rate is 11,580 × 1.011 = 11,710 Btu per kwhr. Col 12 gives input for the month corresponding to the various loads.

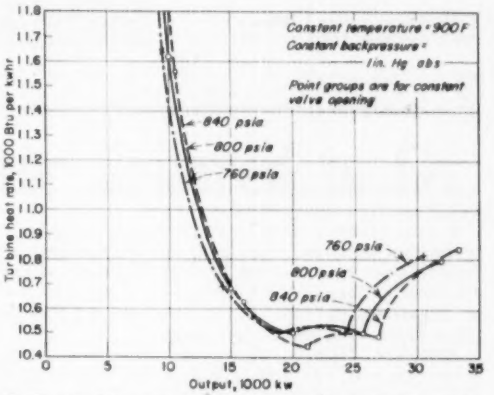
Total Input. Add inputs in col 7 and 12 and divide by total output, col 4, for average heat rate at standard throttle conditions and at actual conditions corresponding to approximated total output in col 4. To figure total expected input into station, first calculate all inputs to individual turbines, as just shown. Then correct inputs to actual metered kwhr. In col 11 we reproduce computed heat rate of 10,839 Btu per kwhr and multiply it by the metered output of 11,302 mwhr to obtain 122,500 × 10^6 Btu.

Now, two more steps give us turbine's expected heat rate. From watthour-meter calibration curves we find the meter has run fast. Integrating the calibration curve with actual load cycle we have a "calibration" correction of 1.0034. Since official actual heat rates are usually not corrected for normal watthour meter errors, this correction brings test performance in line with the effects of a fast meter. Correcting for this condition, 10,839/1.0034 = 10,802 Btu per kwhr. Prior tests show this turbine's heat rate increases on the average by 0.033% per 1000-hr operation. During the month it has run 524 hr so an average correction of ½(524/1000)0.033 = 0.008% applies as an average increase for the month. But up to the beginning of the month the unit has run a total of 6121 hr since its last overhaul. Then, total wear correction = (6121/1000)0.033/0.008 = 0.210%. This makes the wear correction factor 1.0021, admittedly small. Its principal value lies in indicating the reasonable magnitude to attribute to wear. Calculated corrected heat rate = 10,802 × 1.0021 = 10,825 Btu per kwhr. The corresponding turbine heat input = 10,825 × 11,302,000 = 122,344 × 10^6 Btu.

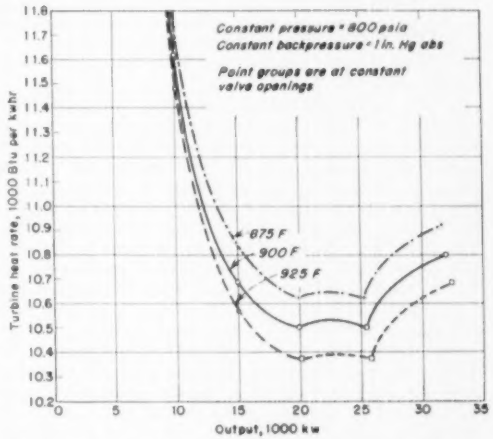
Boiler Efficiency. When a bank of boilers feed several turbines through a common steam header, all turbine inputs, steam auxiliary inputs and miscellaneous losses must be added to find combined boiler output. Dividing this by the boiler average test efficiency gives the combined boiler input. With the flat efficiency curves of modern steam generators, Fig. 2, finding average efficiency is easy. Proportion the total boiler heat output according to actual steam output for each unit. For each boiler divide the apportioned heat output by its number of actual operating hours to determine average



3 Here's how turbine heat rate varies with load and change in backpressure when throttle conditions stay constant



4 Turbine heat rate changes in somewhat irregular manner when throttle pressure changes; other factors constant


Constant pressure = 800 psia
Constant backpressure = 1 in. Hg abs
Point groups are at constant valve openings
875 F
900 F
925 F
Turbine heat rate, 1000 Btu per kwhr
Output, 1000 kw

5 Change in throttle steam temperature causes regular variation in turbine heat-rate curves; other factors constant

TABLE I — CALCULATION OF TURBINE-GENERATOR'S AVERAGE MONTHLY HEAT RATE

Unit No.	Load, mw	Service hours	Output, mwhr	Backpress, in. Hg	Standard heat rate, Btu/kwhr	Standard input, 10^6 Btu	Steam conditions: Temp, F	Steam conditions: Press., psia	Steam conditions: Corr factor	Actual heat rate, Btu/kwhr	Actual input 10^6 Btu
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	10	2	20	0.97	11,580	231.7	885	810	1.011	11,710	234.3
	12	0	—	—	—	—	—	—	—	—	—
	14	1	14	1.07	10,850	151.9	890	795	0.995	10,800	151.0
	16	25	400	1.02	10,620	4,248	897	800	1.002	10,650	4,258
	18	76	1,368	1.08	10,620	14,540	900	800	1.000	10,620	14,540
	20	190	3,800	1.31	10,730	40,780	900	800	1.000	10,730	40,780
	22	0	—	—	—	—	—	—	—	—	—
	24	140	3,360	1.62	10,890	36,580	900	800	1.000	10,890	36,580
	26	63	1,638	1.78	11,030	18,070	900	800	1.000	11,030	18,070
	28	20	560	1.95	11,220	6,284	900	800	1.000	11,220	6,284
	30	5	150	2.00	11,310	1,696	900	800	1.000	11,310	1,696
Total or avg		522	11,310		10,838	122,581.6				10,839	122,593.3
Metered values		524	11,302		10,838	122,490				10,839	122,500
Calibration corrections 1.0034										10,802	
Wear corrections 1.0021										10,825	122,344

load. Efficiency corresponding to average load, Fig. 2, closely equals average steaming efficiency.

If boiler efficiency curve shows pronounced curvature, as it does for older stoker-fired units and units without air heaters, above method cannot be used. Efficiencies at each load must be integrated with total output at each load level to find average efficiency. This is somewhat lower than the efficiency corresponding to average load.

Heat Rate. Table II outlines final calculations for net station heat rate. First three items come from station meters. Item 4 is calculated input to all turbines running in the month; 5 is heat consumption of steam-driven auxiliaries like evactors, standby pumps; 6 sums up all miscellaneous losses supplied from boiler fuel. Log these, Table III, as routine.

Total boiler output is the sum of items 4, 5 and 6. Dividing by the average steaming boiler efficiency gives the steaming input, item 9. Adding the banking fuel gives total station input for the month. Finally, item 12 is overall calculated station heat rate.

In this example the actual station heat rate exceeds the calculated by 0.8%. Now, you may ask, what percentage waves the danger signal? Normally, only the operation of a given plant can answer that. My experience showed deviation always less than ±1% when equipment was in order. ASME *Power Test Code for Stationary Steam Generating Units* states test accuracy may reasonably be considered within ±3%. The older *Steam Turbine Test Code* recommends that each test run be divided into three equal periods, and that the run be considered satisfactory if none of the three periods differs from the others by more than 1%. Actual experience with this analysis indicates Code tolerances as too large.

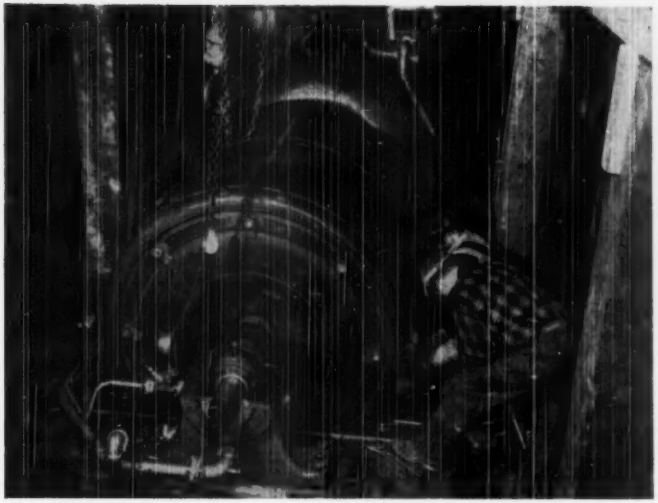
This outlines Part I of the efficiency control method. By the magnitude of deviation, the operator is assured his equipment is in order, or is spurred to inspect it for repair. But up to this point he finds no explanation of why a heat rate changed in a direction contrary to expectation even though equipment is in good shape. That's where Part II comes in. It will appear in August.

TABLE II — CALCULATION OF STATION'S MONTHLY HEAT RATE

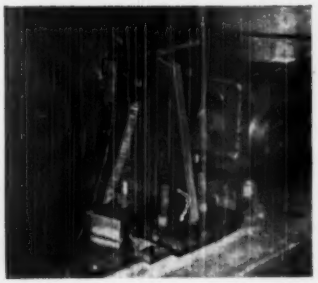
1. Total turbine output, mwhr	38,425
2. Total auxiliary consumption, mwhr	1,546
3. Net station output, mwhr	36,879
4. Turbine total input, 10^6 Btu	416,672
5. Steam auxiliary consumption, 10^6 Btu	940
6. Miscellaneous losses, 10^6 Btu	8,468
7. Total boiler output, 10^6 Btu	426,080
8. Average steaming boiler efficiency	0.861
9. Steaming boiler input, 10^6 Btu	494,870
10. Banking fuel input, 10^6 Btu	1,070
11. Total station input, 10^6 Btu	495,940
12. Calculated station heat rate, Btu per net kwhr	13,447
13. Actual station heat rate, Btu per net kwhr	13,550
14. Deviation of actual from calculated heat rate	0.8%

TABLE III — MISCELLANEOUS STATION HEAT LOSSES

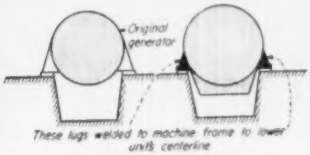
1. Boiler starts
2. Turbine starts
3. Blowdown
4. Drips and free blows
5. Steam lancing
6. Soot-blowing steam
7. Steam siphons
8. Safety-valve blows
9. Overboard feedwater
10. Heater outages
11. Space heating
12. Hydrostatic test water
13. Chemical-injection steam



1 Replacement generator pinch-hitted after new feet were fastened to frame. This permitted using original footings and lining up the generator and prime mover



2 New foot details; this trick saved paying out a large insurance claim



3 Note how brackets allowed slipping temporary generator into old spot

Temporary Generator Tailored to Fit

By **HARVEY OVENU**, *Supervising Engineer, Lumbermans Mutual Casualty Co*

► WHEN THE 1875-KVA 480-v steam-turbine-driven generator suddenly burned we were in real trouble. Examination showed the generator stator coils in eight slots were burned so severely that substantial portions were converted to liquid copper. Large craters formed in stator laminations. This meant a restacking job. Rotating field had a solid ground.

Possible Solutions. Generator rebuilding, including time for removal and reinstallation, would require about eight weeks. Generator furnished power to operate an important portion of the mill during the public utilities peak-hour period. Hence, a costly decision had to be made. If the plant continued to operate during peak hours, a new and costly demand charge would be tacked on. Our alternative was to shut down the plant for the three peak hours each day until repairs were completed. But that meant paying the assured a large hourly *Use & Occupancy Loss*.

If it were possible to get promptly and install a replacement machine, it would not be necessary to follow either of the extremely costly alternatives. Speed being of the essence, a quick search of the market for an identical idle generator was made, but without success. But the hunt revealed an older generator 2500 kva at 2300 v. It was base mounted as shown in Fig. 3 (right). Center of rotating field was 32½ in. from the bottom.

But the damaged generator was supported by integral cast lugs as in Fig. 3 (left). Center was 14 in. above bedplate. Rotation was the same for both so we anticipated no cooling troubles. And, fortunately, the couplings were almost identical.

We hurriedly consulted specialists in this type apparatus. They advised it would be impracticable to substitute the proposed generator for the burned-out unit. And time did not permit waiting for factory prints or preparation of drawings. Preliminary measurements by phone showed that possibilities of making a workable installation were fair. So we decided to attempt it since the financial stake was large.

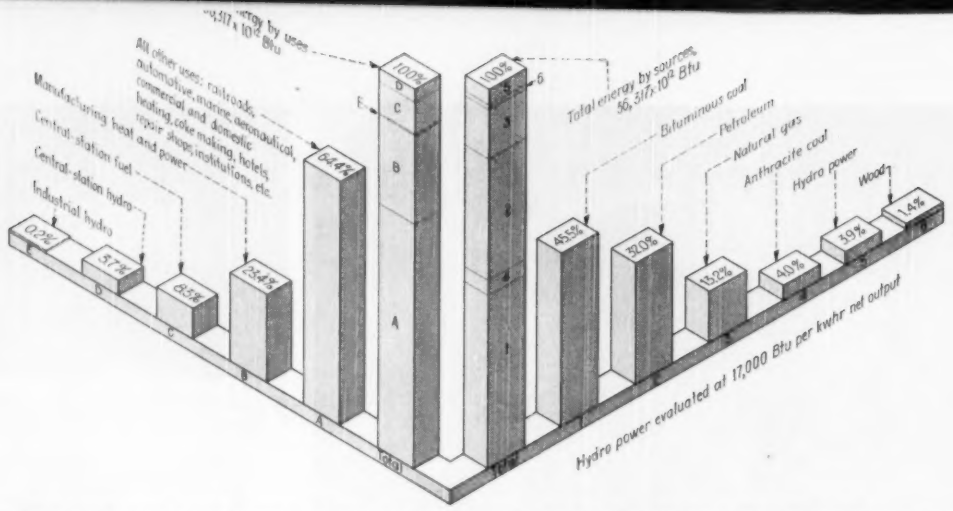
Making It Fit. We made an on-the-spot design to permit mounting the generator on the baseplate along with bringing generator and turbine centers in line. Brackets fabricated of 1-in. welded plate were made up and fastened to the stator webbing by capscrews.

Limited space prevented our using the bracket-mounted outboard bearing of the replacement generator. We used the existing outboard pedestal and bearing after cutting back the babbitt metal to accommodate a shoulder on the replacement field shaft. We removed the oil slinger ring since it fell within the bearing. Resultant oil leakage was collected in a pan, then piped to the reservoir.

Since the plant had a 2300-v circuit some distance from the power-plant switchboard (which was 480 v), we installed an emergency 2300-v board and ran cables to the nearest 2300-v line. Sufficient transformer capacity was present to handle load at 480 v.

When the unit started, severe vibration set in at about 1600 rpm. Evidently the turbine spindle and original rotating field had been balanced as a unit. But a specialist in turbine balance succeeded in getting smooth operation after about 20 trials.

Time required for the installation totaled five days; since starting, the temporary unit has been in constant service carrying full normal load. Many power engineers lean to the belief that generators and turbines must always be tailor-made to each other. In general this is true. But, when necessary, satisfactory combinations can be worked out.

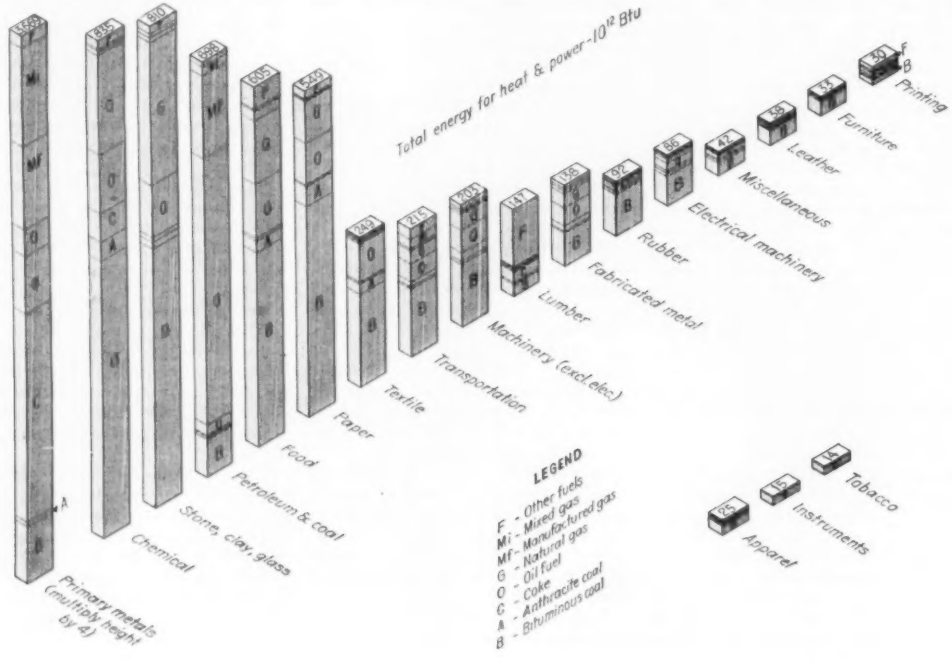


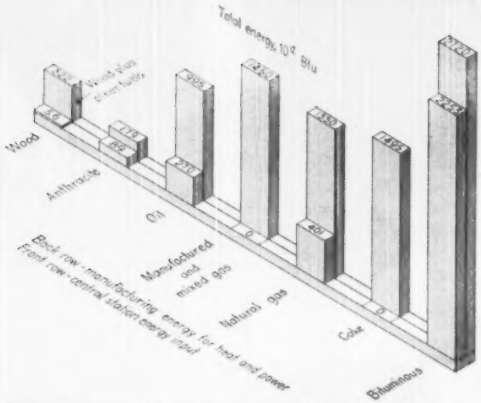
1 About a half of 1947 total energy came from coal. Hydro appears relatively small in over-all picture. Heat and power for manufacturing takes about one fourth total energy, equals about three times fuel consumed by all central stations

Census Data Reveal U. S. Power Pattern

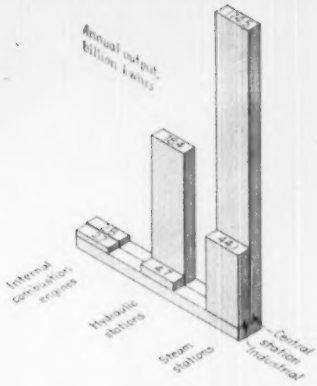
Where does our energy come from and where does it go? *1947 Census of Manufactures* with other data gives most detailed picture yet available

4 In 1947 primary metal industries used 43% of total manufacturing energy consumed for heat and power. These figures exclude fuels used as raw manufacturing material. Chemical, stone, clay, glass, fuel, food, paper combined used 41%





2 Manufacturing industries used wider fuel variety than utility central stations, consumed more of all types in '47



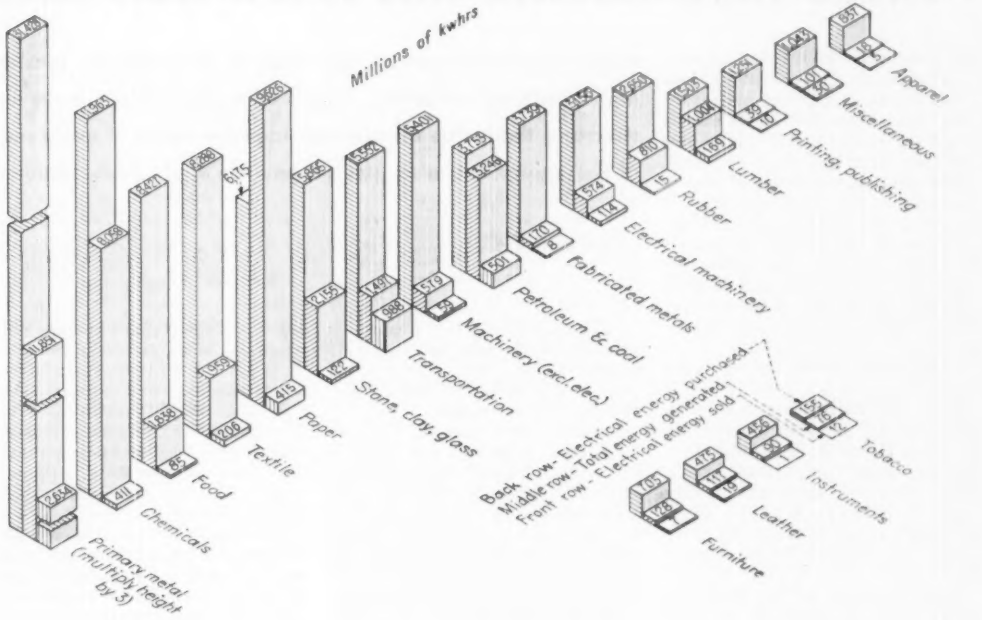
3 In 1947 industrial stations generated about 17% of total electrical energy

► RECENTLY ISSUED by Bureau of the Census, *1947 Census of Manufactures* is the first data with detail on the energy manufacturers consume to meet their heat and power needs. These data, together with those published by the Federal Power Commission, U.S. Bureau of Mines and various fuel institutes, form the basis of these graphs.

We converted fuel quantities to Btu with the following equivalents: 13,100 Btu per lb bituminous, 12,600 Btu per lb anthracite, 11,300 Btu per lb coke, 142,000 Btu per gal oil, 1075 Btu per cu ft natural gas, 550 Btu per cu ft manufactured gas, 500 Btu per cu ft mixed gas, 30c per million Btu other fuels, 17,000 Btu per hydro kwhr.

If we assumed that *all* industrial internal-combustion engine output in Fig. 3 belonged to manufacturers (which is not correct) then at 30% thermal efficiency this output would require about 31×10^{12} Btu of the total 8490×10^{12} used by manufacturers. This would leave 8459×10^{12} Btu for steam generation. Assuming 1100 Btu per lb of steam evaporated, total steam generation equals about 7720×10^{9} lb, at 100% boiler efficiency. At 70% average boiler efficiency, this becomes about 5400×10^{9} lb. Let's assume about 12 lb steam per kwhr average. Then $43{,}936 \times 10^{6}$-$2700 \times 10^{6} = 41236 \times 10^{6}$ kwhr used 494.4×10^{9} lb steam. This leaves about 4906×10^{9} lb steam to process and heating.

5 During 1947 manufacturing industries generated about 85% of industrial electricity shown in Fig. 3. Total energy used by each industry equals sum of purchased and generated, less sold. Primary metals generated 27% of the group total



CHEMICAL-RECOVERY UNIT: *Left:* recovery furnace's preheated air duct and connections to the furnace. *Right:* instrument, recorder and control panel for a unit with a boiler that produces 137,000 lb of 175-psi saturated steam per hour

These Instruments Put Know-How Into

Modern chemical-recovery unit with its steam boiler runs at high efficiency, reliability. Here's an outline of the many instruments that guide the operator in performance of every part of the equipment; also, tips on how to apply data obtained

By **R M BROWN**, *Instrumentation Engineer, Stadler, Hurter & Co, Montreal, Quebec*

► MODERN RECOVERY FURNACES, originally designed to recover chemicals in spent cooking liquor from the sulfate-pulp process, are also highly efficient steam generators. This type of furnace and boiler represents a large investment, which along with operating expense is justified only by the chemicals recovered and steam produced. These returns may be increased by adequate instruments that reduce operating and maintenance costs while ensuring maximum chemical recovery and efficient waste-heat use. Before talking about the instruments, let's take a look at the process.

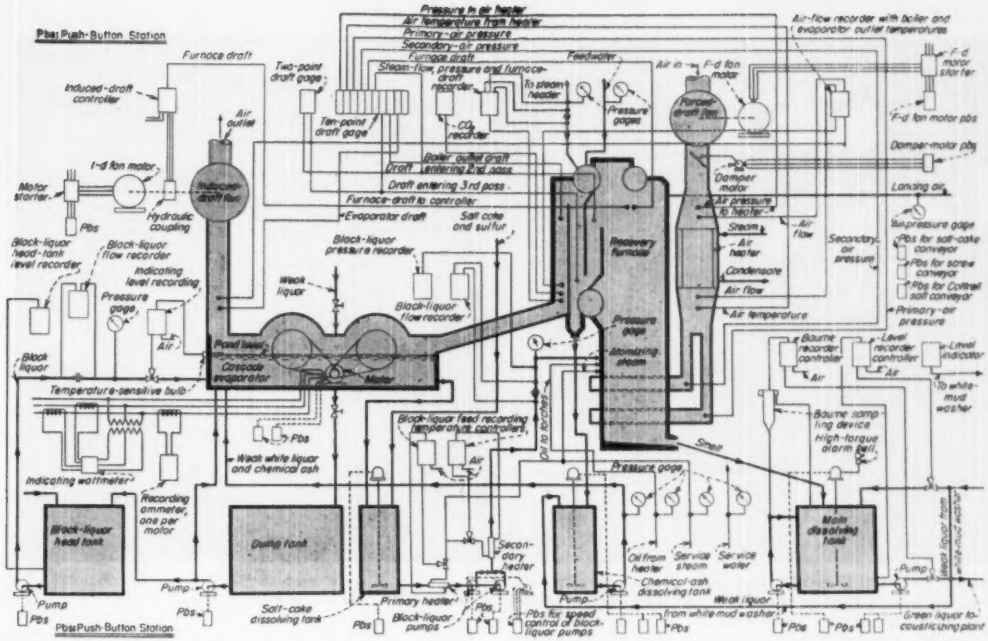
Pulp-Making Process. Sulfate pulp is made from wood chips loaded into a digester and cooked in a liquor containing several chemicals. Active compounds in the cooking liquor are sodium sulfate, sodium hydroxide and others. When filled with chips and cooking liquor to the proper level, the liquor is heated with live steam and the chips cooked under pressure for two to eight hours.

Under action of the hot alkali the woody matter is dissolved from the cellulose fibers of the chips. After a suitable period, digester pressure is reduced, and the pulp and liquor are blown into tanks. Flash steam from the "blow" heats water for washing in a blow-heat-recovery system.

The pulp goes to washers, where the spent liquor is removed and stored in tanks. This "black" liquor contains most of the chemicals used in the cooking process and the organic matter from the wood, such as lignins and various acids. Total weight of organics in the liquor equals about one half of the weight of the chips put into the digester.

Cascade Evaporator. The dilute black liquor containing only 12 to 20% solids is pumped to multiple-effect evaporators where the solids' content is raised to 45 to 60%. Some systems use concentrators following the evaporators to obtain liquor with 70% solids. In other systems, like the diagram on facing page, liquor from evaporators goes to a head tank and from there is pumped to a combination evaporator-scrubber called a cascade evaporator.

This evaporator consists of a closed chamber, which is placed ahead of the recovery furnace and through which the hot flue gas passes. Unit contains a pool of black liquor into which dip baffle plates concentrically mounted on a



INSTRUMENT LOCATION: diagram of a recovery unit and its associated equipment shows the different types of instruments, recorders and controllers, also the points where they are connected on the process as well as on the steam-making unit

Chemical-Recovery Unit's Operation

rotating shaft. **Baffle plates** make the flue gas follow a twisting path and continually expose a film of black liquor to the gas stream. This action further concentrates the liquor and scrubs chemicals from the gas. Practically all the remaining chemical ash is removed in an electrical precipitator before the gas is released to the stack and atmosphere.

The black liquor, now containing about 68% solids, flows to the chemical mixing tank where the necessary make-up salt cake (sodium sulfate) is added. Sulfur may also be added to raise the sulfidity. It is then pumped to the recovery unit's furnace.

Recovery-Unit Furnace. A modern chemical recovery-unit furnace does the following: (1) removes remaining moisture in the black liquor (2) burns organic compounds in it (3) reduces to a smelt the inorganic chemical to be recovered (4) uses heat of combustion to generate steam in the boiler. The recovery-unit furnace is brought up to temperature by firing with oil or wood. Fuel oil is also used to maintain steam output if black liquor is too dilute or not available. When the furnace is hot enough, hot black liquor is sprayed in through oscillating burner nozzles. The remaining water is evaporated and the carbonaceous matter and volatiles burned.

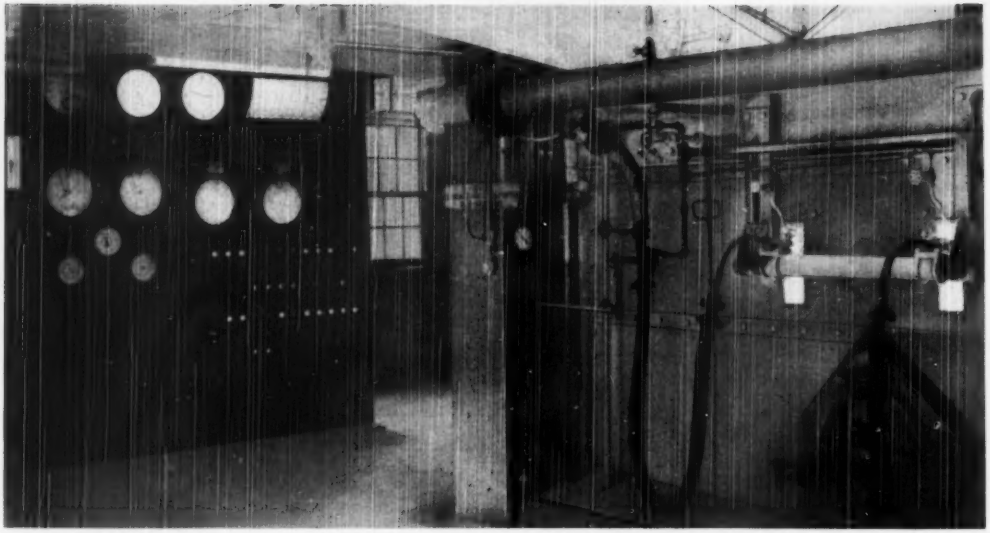
Black ash from the dried liquor falls to the bottom of the furnace. Here the carbon burns, generating more than enough heat to melt the inorganics. This smelt is tapped off continuously into a green-liquor tank where it is dissolved in weak white liquor. Green liquor is recausticized in another part of the plant and returned to the pulp-making process as highly caustic white liquor.

Instruments and Controls. Production of smelt, having a high content of the chemicals to be recovered, is the primary purpose of a recovery unit. Steam generation is secondary, but since efficient use of waste heat contributes to recovery-process economy, the furnace should be equipped with instruments and controls essential to good operation. Heat balances must be made at intervals. These are obtained quickly and accurately if indicating or recording instruments are installed to provide the factors needed to make up the balance.

Early recovery units used few instruments. But as furnace size grew and need for accurate operating data was better appreciated, more instruments were installed until today instrumentation is like that of any large steam-producing unit.

Fuel Level in Tank. Fuel in the furnace, as previously mentioned, is the black liquor from pulp making. It is stored in the black-liquor head, or surge, tank—lower left-hand in drawing above. A knowledge of available fuel is necessary for good operation, so the level in this tank is recorded. As the tank is vented to atmosphere, an air purge, or bubbler type of level-measuring system, is used. To maintain correct liquor temperature, some mills install, in the head tank, steam coils that have an indicating-temperature controller with an air-operated control valve.

From the head tank, liquor is pumped or flows by gravity to the spray tower or cascade evaporator. While black liquor flow is difficult to measure, some mills find the record of value. A thin plate orifice and differential manometer



BOILER OPERATING FLOOR: Instrument and control panel, on *left*, for boiler operation. *On right*, two black-liquor nozzles mounted on a shaft that oscillates them up and down in furnace. When needed, oil can be burned in separate nozzles

type meter are used, but the liquor must not enter the differential-pressure lines. If liquor entered the meter lines, it might cool and plug these connections. To prevent this, a continuous steam purge operates much as the air purge on a level-measuring system.

Another flow-measuring system uses an area-type meter. In this unit, the plug positions an armature in an induction-balance transmitter that in turn positions the recorder pen. A steam-heated jacket prevents the primary element containing the plug from freezing up.

Cascade Evaporator Operation. If the Combustion Engineering system is used in the cascade evaporator, liquor level in the pond must be maintained within close limits to ensure uniform liquor density and maximum scrubbing efficiency of flue gas. Since for many reasons the usual liquid-level measuring system is unsatisfactory, a temperature system is used. The temperature-sensitive bulb in a protective socket is inserted horizontally through the evaporator's steel wall at the level desired. If the level drops, bulb is exposed to hot flue gas and the controller opens the valve in the liquor-supply line to raise the level. As it rises and the bulb is submerged, the controller closes the valve. Liquid level is held within plus or minus ½ in. to eliminate trouble due to floats sticking.

Constant-speed motors drive the rotary baffles in the cascade evaporator. Should liquor density rise, the current taken by the motors increases. Motor load may, therefore, be taken as a measure of liquor density. Recording ammeters, installed in the motor lines, reveal any abnormal conditions. If liquor density increases, the operator opens a valve to let weak white liquor flow into the evaporator. Usually an indicating wattmeter shows total power taken by the evaporator. If power fails, or the recovery unit breaks down, a valve is opened and the liquor in the evaporator is dumped to a tank and later recirculated. Temperatures of flue gas leaving the boiler and evaporator are recorded as a check on evaporator operation.

Liquor Heaters. From the evaporator, the liquor flows to the chemical-mixing or salt-cake-dissolving tank where salt cake and sulfur are added. From here the liquor goes to a primary heater where it is heated by direct steam injection. It is then pumped through a secondary heater. Both heaters have temperature-recorder controllers to regulate steam flow to the heaters. The liquor must be heated to flow through the spray nozzles on the furnace.

Black-liquor flow to the furnace may be adjusted by changing the speed of the centrifugal pumps between the two heaters. A control device on the hydraulic coupling, between pump and motor, permits the operator, from a pushbutton station, to adjust flow to the burners as required. Black-liquor pressure in the feed lines may be measured by a pressure recorder with a filled system and a diaphragm-type element.

The instruments described are on the liquor supply. Neglecting the furnace itself for a moment, let's consider instruments on the product output. The smelt, flowing continuously from the furnace, is broken up by a liquor spray as it enters the main dissolving tank. Here it dissolves readily in weak white liquor from the causticizing plant and is constantly agitated and recirculated. Level in the tank is maintained by a level recorder, which actuates a valve in the weak white-liquor line.

Liquor-Density Control. Since the green-liquor density in the dissolving tank must be maintained within close limits for best operation in the causticizing plant, this density is controlled. This can be done by pumping a liquor sample to a constant-level chamber and measuring, on a bubbler-type differential-level recorder controller, the changes in head due to changes in density. Several combinations of bubble pipes and reference chambers are possible. The controller operates a valve in the green-liquor outlet line to the causticizing plant. If density drops, the valve closes to hold the green liquor longer in the dissolving tank. When liquor density increases, the valve opens to let the green liquor flow out. Such action causes changes in level, and the level controller operates to de-

crease or increase the flow of weak white liquor.

One mill obtained better density control when the density controller operated the weak white liquor-line valve and the level controller operated the valve in the outlet line. The constant-level chamber, or density-sampling chamber, as it is called, should be of fairly large diameter with inlet and outlet connections not less than 1 in. in diameter, preferably more to prevent plugging.

Furnace Instruments and Controls. Returning to the furnace, let's look at the various instruments and controls in common use. Air for combustion is supplied by the forced-draft fan. It passes through an air heater, which may be either a steam-heated type placed just after the fan, or a tubular type in the flue-gas exhaust duct. The total quantity of air is metered, the common practice being to take the drop across the air heater as a measure of the volume. An air-flow recorder is used.

The air supplied is split: Primary air is supplied just above the smelt level, while secondary air is supplied at a higher level. Ducts carry the primary and secondary-air to nozzles as in the furnace walls. Dampers in the primary- and secondary-air ducts, as in the individual nozzles' ducts, permit air-flow control for best results. The primary air supplies the oxygen necessary to convert carbon in the ash to carbon dioxide, without oxidizing the sodium sulfide. Secondary air completes the process and provides hot air to aid in drying the liquor as it enters the furnace.

Combustion Air. Forced-draft air is controlled by a damper positioned remotely by the operator. This air volume bears a relation to the steaming rate, so usually the furnace builder will provide a table of air volumes for various steaming rates. The primary and secondary air dampers, once adjusted for proper air proportions, remain unchanged for a long period; hence they are set manually.

Forced-draft air pressures at points ahead of the air heater and in the primary and secondary air ducts are indicated on a multiple-point draft gage. These data provide information for the operator to check the pressures and condition of the air heater.

Air temperature from the air heater is also indicated on the multiple-point gage. If a tubular air heater is used, it is customary practice to use a 4-pen temperature recorder to record inlet and outlet gas temperatures, and inlet and outlet air temperatures. These records are useful when running a heat balance on the furnace and also serve to check air-heater efficiency.

Furnace draft is measured by a furnace-draft controller, which maintains proper draft by regulating the oil volume in the hydraulic coupling on the forced-draft fan, or by positioning intake vanes or damper, or both, on the fan. Furnace draft is also indicated on the multiple-point gage.

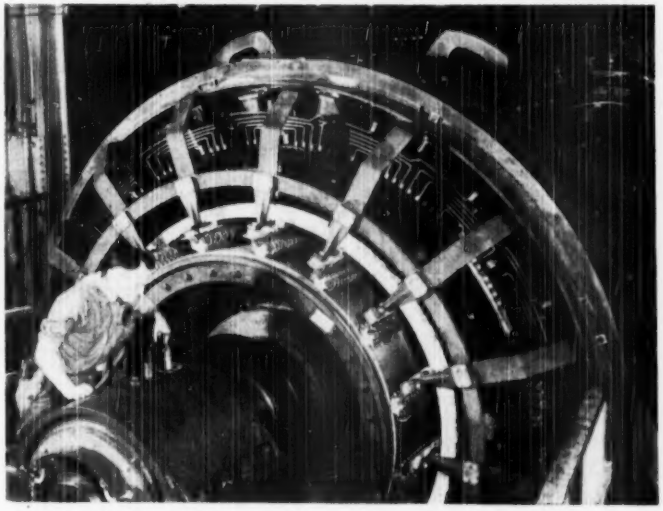
Second-pass, third-pass and boiler-outlet drafts are all indicated on the multiple-point gage. These pressures are used to check deposits on boiler tubes. The boiler outlet draft may also be recorded.

Evaporator outlet draft is usually indicated. For checking the operation of the evaporator, inlet-gas temperature (boiler outlet-gas temperature) and its outlet-gas temperature are recorded.

Steam-Boiler Instruments. On the steam-producing end of the unit are those instruments and controls in common use on steam-generating units. These include a feedwater-control system, usually provided separately by the purchaser, a feedwater pressure gage and recorder, and a feedwater flow recorder. A boiler-drum level recorder may also be used. A steam-flow recorder, a steam-pressure recorder and steam-pressure gage are standard equipment.

Some of these instruments may be combined where related records would have value. Combinations used depend on the manufacturer's practice or the buyer's preference. For example, one user may prefer to record steam flow and black-liquor flow on the same chart, thus relating steam flow to fuel flow. Another may prefer to have steam flow and total air flow on the same chart, thus relating steam flow and air flow. Steam pressure may be recorded separately or on the same chart with the steam flow. There is no reason why various combinations should not be used, but it is advisable to combine those that bear an obvious relation to each other.

In addition to the instruments listed, many others provide useful information. These are usually indicators. Pressure gages are used on the various auxiliary supply lines, including service water, air, steam and fuel oil. So many factors are involved in metering problems that for the most economical solution, when the plant is being designed, there must be close cooperation between the manufacturer of the recovery furnace and the project, electrical and instrument engineers.



LARGEST TWIN DRIVE ever built for steel-mill industry is being assembled at General Electric for final test before shipping to Lukens Steel Co, Coatesville, Pa. This reversing unit replaces 15,000-hp twin-tandem cross-compound steam engine that now drives 206-in. 4-high mill. New twin drive has continuous torque rating of 1,400,000 lbft and maximum torque rating of 3,850,000 lbft. The drive consists of two 4000-hp, 30- to 75-rpm, 6000-v reversing motors. One is directly connected to the top work roll and the other to the bottom work roll of the mill

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

27—Electronic Smoke-Density Indicators: Part 3

► INDICATORS AND RECORDERS for smoke or haze density have several purposes. Some serve as combustion-efficiency guides, while others are intended only to help the boiler operator keep flue-gas density within legal requirements. If flue-gas density exceeds these limits, the recorder shows when the violation occurred and how long it lasted. The General Electric indicator in Fig. 1 is of the latter design.

Phototube Type. It is in some features quite different from the unit's we studied in previous articles. The green lamp lights continuously as long as smoke-density remains within safe limits. In other designs this lamp remains dark except when the flue-gas density indicates an over-amount of excess air. In Fig. 1 when legal smoke limits are exceeded, the green lamp goes out and the red lights to warn the operator. If desired, an alarm is sounded as an added warning.

An indicating lamp L_1 on the control panel is connected in series with the light source at the stack. As long as the indicating light burns, it shows that the phototube light source is in service.

Tubes T and T_1 are in a single dual unit, but are separated in the diagram to simplify the connections. Their cathode-heater terminals X and X_1 are grouped in parallel and connect to transformer secondary terminals X and X_1. Cathode-heater terminals Y and Y_1 connect to terminals Y and Y_1. This transformer section also supplies power for the red and green lamps.

Indicator Operation. With these preliminaries, let's study the circuits and how the control operates. Tube T_1 serves as a half-wave rectifier to supply phototube P and voltage divider R_6, R_8 and R_7. Capacitor C_2 across tube T_1 terminals serves as a filter to smooth out the half-wave current flow. Tube T is grid controlled and supplies power to the relay coil where tube T_2 supplies the smoke meter and recorder, when the latter is used.

Light-source lamp L connects to 115 v through indicating lamp L_1 in series. Arrowheads indicate current flow. Amount of light reaching phototube P varies with flue-gas density, which we will assume is about 20% or No. 1 Ringelmann. Then current flow through the photo tube is about normal.

This circuit is from − on the 60-v transformer section, tube P, potentiometers R_2 and R_1, though tube T_1 to + on the transformer. Tube T_2 grid is given a minus bias from the contact on R_2 to the grid and cathode, R_5 to the contact on R_1, through the top half of R_1, tube T_1 to + on the transformer. This bias equals the volts' drop between the contacts on R_2 and R_1, less volts' drop across R_5. The latter varies with the current flow through tube T_2, being a minimum for a clear stack and a maximum for 100% smoke.

With normal light reaching the cathode of phototube P, grid bias or T_2 holds current flow through this tube to 1 ma. The smoke meter then reads No. 1 Ringelmann, or about 20% smoke. Circuit through tube T_2 is from minus on the 180-v transformer section through R_5, R_6, tube T_2, the smoke meter, back to the transformer.

Tube Bias. Tube T grid is biased from the 60-v transformer section from A through R_4, R_3 and R_1 through tube T_1, to + on the transformer. Current flow through this circuit is very low because R_6, R_8 and R_1 have a combined resistance of 4.25 megohms. Minus potential applied to tube T grid is from R_3 contact, through R_9, to the grid and cathode, R_7 to R_1 contact. This potential equals that between R_3 and R_1 contacts, less volts' drop across R_7. The latter gives control of the grid.

Because of the high resistance of R_1, R_3 and R_1, voltage drop between contacts R_3 and R_1 is fairly constant, but varies across R_7, which has 10,000 ohms resistance. Current through R_7 and the smoke meter varies from 0.5 ma for a clear stack to 3 ma for 100% smoke or No. 5 Ringelmann.

So volts' drop across R_7 with a clear stack is only $10{,}000 \times 0.0005 = 5$ v, and for 100% smoke is $10{,}000 \times 0.003 = 30$ v, or a change of $30 - 5 = 25$ v. This resistor acts as a variable-voltage battery connected in the grid circuit in opposition to the grid bias of tube T. This bias is highest when the stack is clear and a minimum on 100% smoke. At 20% smoke, bias on the grid is sufficient to keep current flow through tube T down

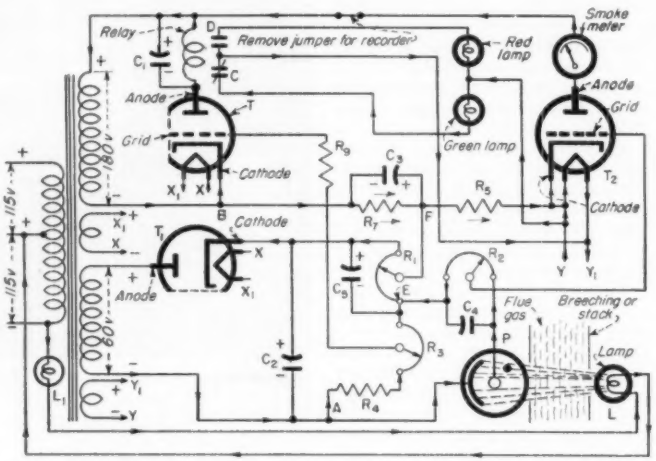


Diagram of a smoke-density indicating and recording system, designed to assist the boiler-plant operator in keeping flue-gas density within legal requirements

ANOTHER complete piping job by Shaw
New Steam Electric Station, Units #1 & #2, of the Texas Electric Service Co., Wichita Falls, Texas... now being completed. 26,000 KW extension. All piping prefabrication in this new unit was supplied by Benjamin F. Shaw Co. Operating pressure—650 PSI, operating temperature—835° F. Ebasco Services, Inc., Engineers.
SHAW

fabricates and erects piping to fit your needs EXACTLY

Benjamin F. Shaw Company is qualified to pre-fabricate and erect piping throughout the World.

President

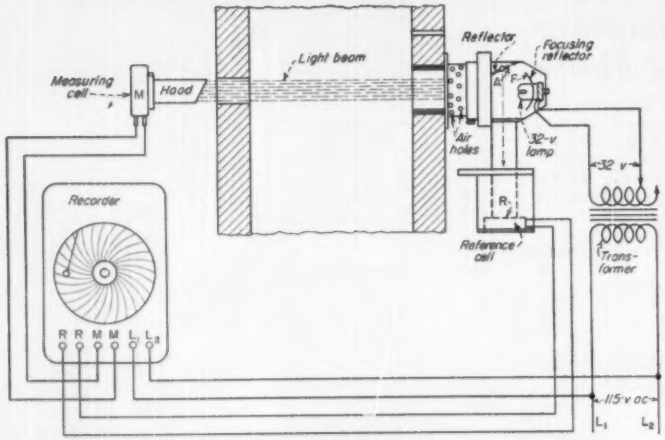
Dependable, accurate piping... checked, cleaned, rigidly tested every step of the way... ready to give you superior, money-saving performance. Shaw engineers carefully analyze each individual contract—translate your requirements for most efficient handling—deliver on schedule. Complete, modern facilities plus new techniques permit Shaw to give you the best in piping fabrication service... always.

BENJAMIN F. SHAW COMPANY

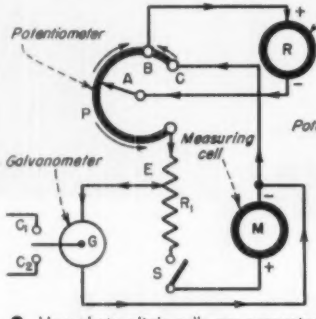
2nd & Lombard Sts. Wilmington, Delaware

KNOWN SINCE 1893 FOR HIGH-QUALITY PIPING PRE-FABRICATION AND INSTALLATION

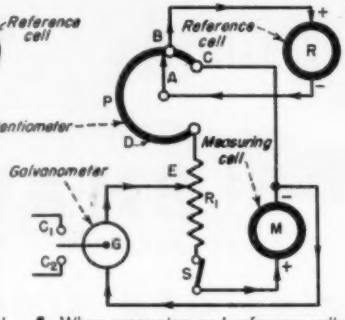
Photovoltaic Cells Used in Smoke Indicator



2 Smoke-density recorder uses two photovoltaic cells, one a measuring, the other a reference unit. Difference in light reaching them indicates smoke density



3 How photovoltaic cells are connected inside of the smoke-density recorder



4 When measuring and reference cells are connected, recorder's in service

below a value that will activate the relay. Contact C remains closed to light the green lamp, while D is open so the red lamp stays dark.

Dense Smoke. When the smoke becomes dense and cuts off light to the phototube it ceases to conduct. Bias is removed from tube T_2 grid and it conducts maximum current (3 ma) and the smoke meter indicates 100% smoke.

When the phototube ceases to conduct there is still a minus potential applied to the grid of tube T_2 from E on R_1, through part of R_2 to the grid and cathode R_3 back to R_1 contact. At the same time, volts' drop across R_3 opposes the bias on the grid of tube T_2. If these two potentials are equal they cancel out and the grid has zero bias.

When the current increases to 3 ma through tube T_2, volts' drop across R_3 increases to 30 v as previously explained. This voltage practically removes the bias from tube T; it permits maximum current to flow through the relay coil, which closes contact D and opens C. Green lamp then goes dark and the red lights to call attention to the smoke condition. Additional contacts, not shown on the relay, can sound an alarm or perform other functions when they close, such as to operate a recorder, control blowers, open dampers or operate other smoke-reducing devices.

Indicator Adjustments. The equipment is adjusted to actuate the relay as the smoke approaches an objectionable or unlawful density. Adjustments are made with potentiometers R_1, R_3 and R_2. R_1 adjusts for full scale or 100% reading of the smoke indicator. With no light reaching the phototube a minus potential is applied to the grid from E on R_1 to the contact on this potentiometer, as previously explained. If R_1 contact were on E, grid potential from this source would be zero for highest current flow through tube T_2. Moving R_1 contact to its top position increases the grid bias to reduce current flow through the tube and the reading of the smoke-density meter. R_1 is so adjusted that when no light reaches the phototube P, the smoke meter indicates 100% smoke.

Potentiometer R_2 serves as the zero adjustment on the smoke-density meter. With the stack clear and with full light on the phototube, R_2 contact is moved until the meter reads zero. Moving R_2 contact to the right reduces the meter's reading while moving it to the left increases the reading.

R_3 adjusts the bias on the grid of T so the relay functions at the desired percent smoke. Moving R_3 contact down increases the grid bias and delays closing relay contact D, whereas moving it up reduces the grid bias; relay closes and signals at a lower-smoke density.

Capacitors C_1 and C_2 connect across potentiometers R_2, R_1, and C_3 across resistor R_3. These serve to smooth out the current flow through the resistors and maintain constant-voltage drop across them during a given smoke condition. Capacitor C_1 helps to steady current flow through the relay coil to keep contact D from chattering when closed.

The Photovoltaic-Cell Type is also used in smoke indicators and recorders, and in combustion control. As explained in March POWER, p 120, these cells directly convert light into electric energy. The Bristol Co smoke recorder, Fig. 2, uses two cells. On the right-hand side of the stack is the light unit somewhat similar to that used in an electron-tube smoke indicator.

Light unit has focusing reflector F, which throws a light beam across the stack onto measuring cell M. Light on this cell varies according to the density of the stack gases. Its output is, therefore, a measure of gas density.

A second reflector, A, in the light unit directs a light beam down onto a reference cell R. Voltage developed by this cell is constant at a value corresponding to clear-air conditions. The two cells are connected to the recorder so their voltages oppose. Their difference being a measure of smoke density is used to actuate the recorder.

The light is powered from a 115- to 32-v transformer. This unit has a tapped secondary so voltage at the lamp can be adjusted to 32 v, even if primary volts may be above or below 115 v. The recorder is also operated from the 115-v line as shown.

Recorder Operation. Fig 3 diagrams the way the photovoltaic cells connect

(*Continued on page 166*)

"HOTTER, SOONER" Saves YOU MONEY

Yarway Impulse Steam Trap with new stainless steel body.

Yarway Impulse Steam Traps get equipment hot and into production *faster.* Extra profits!

Then they keep it *continuously* at peak operating temperatures for maximum production. More extra profits!

What's the reason for *hotter, sooner?* Just this. When steam is turned on, Yarways open wide, discharging the air and condensate *in a hurry* —closing only when steam arrives. Then, when operating temperature has been quickly reached, the little valve (only moving part) literally *floats on the load*... discharging heat-retarding condensate as soon as it forms instead of waiting for quantities to accumulate. Thus equipment is held at peak operating efficiency.

Other economical features of Yarway traps—minimum maintenance, easy installation, low initial cost.

More than 600,000 Yarways have already been installed. Sold by distributors throughout the world.

Try a Yarway today... standardize on Yarways tomorrow.

YARNALL-WARING COMPANY
100 MERMAID AVENUE, PHILA. 18, PA.

Nest of Yarway traps installed with Yarway Strainers on cloth dryer. Note small space required.

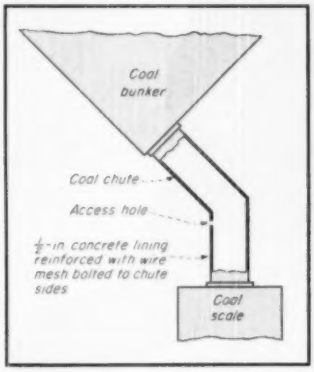
Stainless Steel Body

YARWAY IMPULSE STEAM TRAP

POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE

CONCRETE LINING AVOIDS REPLACEMENT OF COAL CHUTES



CHUTES IN OUR PLANT were deteriorating from coal abrasion and moisture. These chutes connect the bunker outlet and the coal-scale inlets as shown in the sketch. There are nine altogether. To replace these welded-plate structures would have cost us a total of $675.

We decided to line each chute with concrete. The metal was originally 3/16 in. thick. We scheduled our operation to empty a boiler coal bunker so three coal chutes feeding a single boiler could be disconnected at a time.

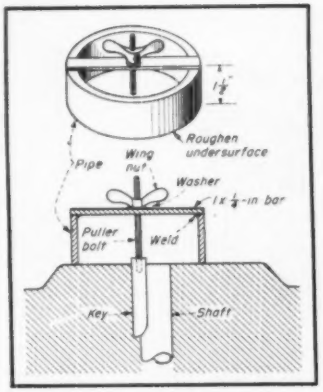
An access hole was cut in the front of each coal chute. Through this hole a rod can be worked whenever the coal hangs up.

We then shaped medium-wire mesh to each inner side of the chute. This was held in place by four bolts at the corners of each side. We troweled a smooth layer of cement ½ in. thick to cover the wire mesh. After reinstalling the chutes with the linings we placed the words DO NOT POUND in large letters on their sides. The entire repair job cost us only $225 for material and labor.

An alternate method of reinforcing the concrete lining would be to anchor light rods of about ⅛-in. dia on the chute sides. This would probably cost more than the wire mesh.

ALLAN ROCKLIN *Chicago, Ill.*

HERE'S HOW TO PULL STUBBORN SHAFT KEYS IN A JIFFY



SQUARE, FLAT, SADDLE and tangent keys are often hard to remove after long periods of service. Rust and nicks make them stick just when you are in a hurry to tear down a machine for repairs. We solved this problem by making several key pullers, as shown in the sketch.

We cut off 1½-in. lengths of 2, 4, 6 and 8-in. scrap pipe and roughened up one end of each piece. Then we welded 1-in.-wide by ¼-in.-thick flat bars to the smooth end of the pipe sections. Center of the bars was drilled with holes of ¼-in. dia. A fine threaded bolt fitted with a washer was inserted through the hole. A wing nut rides on the puller bolt and washer as shown.

Sticking keys were drilled and tapped to fit one of the puller bolts. Key tapping was kept as small and shallow as possible, maximum depth being about ¼ in. for most keys. Tapping diameter was made proportional to key size, preventing excessive weakening which might result in shearing.

To use, screw puller bolt into key. Place pipe section over shaft-end frame with puller bolt projecting through bar hole. Run the washer and wing nut on the bolt. Tighten nut until key moves. Usually it can then be removed by hand. Tighten wing nut gradually by hand because using a wrench might strip the threads.

TYLER G HICKS *New York, N. Y.*

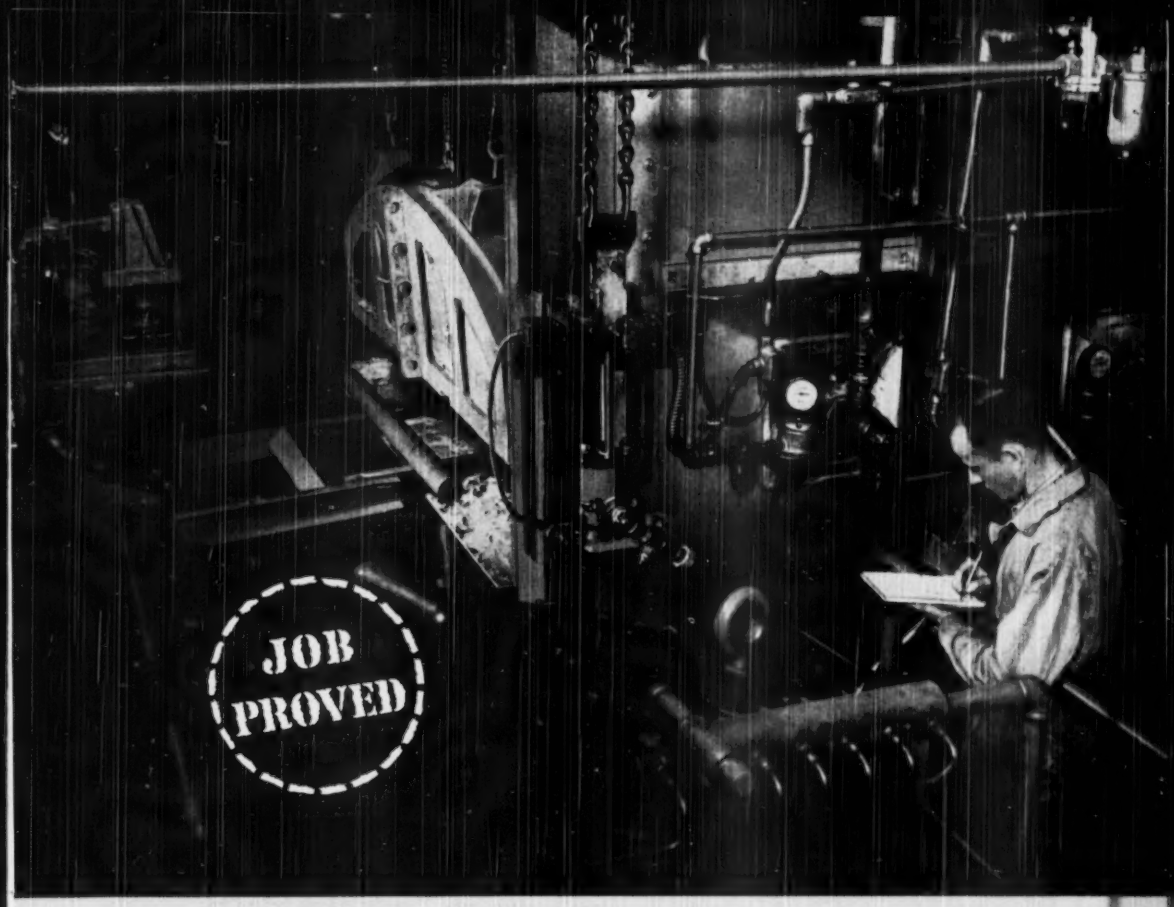
KEEPING ACCESSORIES HANDY AVOIDS LOSING TIME

WHEN TAKING A BOILER out of service we remove the high-low-water alarm whistle and replace it with a plugged coupling. This lets us fill the boiler completely and put it through a hydrostatic test without having water spraying out of the whistle and damaging equipment. Often whistles and plugs used to be misplaced, causing inconvenience and loss of time.

Our assistant chief corrected this difficulty by having a basket and plugged coupling made for each boiler. The basket, of light tubing and welding rod, was large enough to hold the alarm whistle. Both basket and plug were permanently attached to the back of the water column by light chains. A whistle taken off is now immediately placed in its basket, and the plug, being at hand, can be substituted without any delay and inconvenience.

J A SWANSON *Princeton, B. C.*

(*Continued on page* 132)



HYDRAULIC SYSTEM KEPT LIKE NEW

Sunvis 916 Effects Substantial Savings; Strainers and Lines Kept Sludge-Free

A copper tubing manufacturer uses an oven with hydraulically operated doors to heat billets to approximately 1550F. The ambient temperatures around the hydraulic mechanism are abnormally high, putting the hydraulic fluid to a severe test of stability. Failure of the system would halt the piercing operation and result in costly delays throughout the plant.

Since the oven was first put in operation, three years ago, the hydraulic fluid has been Sunvis 916. The original charge has never been changed and is still in excellent condition, though the system is tight and requires only a minimum of make-up. Oil lines and strainers are completely free of sludge. Seals and packings are sound. Operations are never interrupted for oil changes or parts maintenance. The company expects to retain the original charge of Sunvis 916 in service indefinitely, effecting large savings in both oil and maintenance costs.

Sunvis 916 is a solvent-refined oil of the highest quality. It is fortified to resist the oxidation and sludging so detrimental to the efficient operation of hydraulic systems. Sunvis 900 Oils are *good for the life of your machines*. For your copy of the illustrated booklet "Sunvis 900 Oils" write Department P-7.

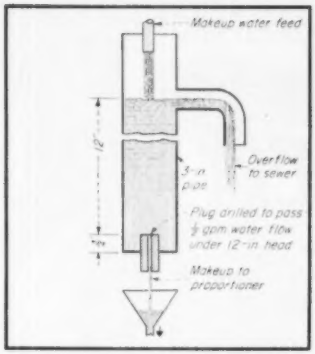
SUN OIL COMPANY · *Philadelphia 3, Pa.*
In Canada: Sun Oil Company, Ltd.
Toronto and Montreal

SUN PETROLEUM PRODUCTS
"JOB PROVED" IN EVERY INDUSTRY

SUNOCO®

 Continued from page 130

CONSTANT-HEAD TUBE SUPPLIES STEADY WATER FLOW



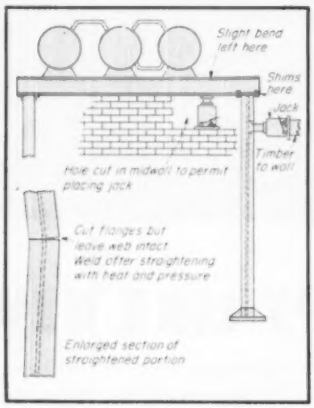
THE CHEMICAL PROPORTIONER for our lime-soda-ash hot-process softener must have a constant makeup-water supply of ½ gpm. Any variation in this flow used to throw our treatment process way off. We controlled makeup by a valve, but as pressure varied the flow would change unless valve setting was adjusted. Scale clogging the cracked-open valve often stopped the flow.

To correct this condition I installed the constant-head tube in the makeup line between valve and proportioner. As the sketch shows, it is made of 3-in. pipe with a plate welded at bottom. A plug with an accurately drilled hole was fitted in the bottom. The hole passes ½ gpm with a 12-in. head of water above it. At the 12-in. level an overflow pipe was fitted into the side of the 3-in. tube.

The tube allows opening the feed valve enough to pass ½ gpm with lowest supply pressure. Scale doesn't collect now in the valve which is opened wider. Scale can collect for a considerable period in the bottom of the tube. From there it can be easily removed. If it accidentally plugs up the bottom hole, it's a simple matter to clean and exactly reestablish the needed makeup flow. Water flow is always visible, easily checked.

C WERDERITCH *Albert Lea, Minn.*

HOW WE STRAIGHTENED A STRUCTURAL STEEL COLUMN


Slight bend left here
Shims here
Jack
Timber to wall
Hole cut in midwall to permit placing jack
Cut flanges but leave web intact. Weld after straightening with heat and pressure
Enlarged section of straightened portion

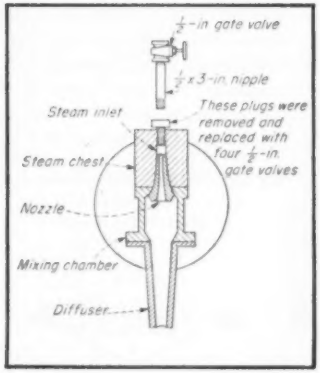
AFTER ABOUT 20 YEARS of service one of the front center columns supporting one end of the drums of two Stirling boilers bent about 6 ft from the top. The battery wall between these two boilers had partly failed and allowed the steel to overheat. There was also a very slight bend in the beam under the drum ends. A thorough inspection showed that the steel did not suffer any damage or thinning. We decided to straighten the column in place rather than replace it.

We cleared all brick away from the column to give easy access. Then we took down the battery wall to a height allowing placing a hydraulic jack between brick and beam, see sketch. This jack was raised to give full support to the beam carrying the drum ends. Column flanges were cut as indicated. Next, the bolts holding the beam clips to the column were loosened.

A second jack, based on timbers supported by the building steel, then forced the column back to its original position. To reduce the force, the column web was heated with an acetylene torch. Welding up the cuts completed the repair on the column. Placing shims between outside end of the beam and clip on the column helped bolt the column top securely. The slight bend in the beam was left in, because it was barely noticeable. We would normally not recommend patchwork of this nature. In this case the boilers were used only for standby so we could not justify the expense of complete replacement.

J C PORTER *Rock Hill, S. C.*

GATE VALVES SPEED NOZZLE CLEANING ON AIR EJECTORS



OUR STEAM-JET AIR-EJECTOR nozzles plug up with boiler carryover at regular intervals. To maintain vacuum we must clean them with minimum delay. Our turbines run continuously except for annual inspection periods. We clean nozzles at regular intervals and rarely run into low-vacuum conditions.

All steam nozzles were originally equipped with steel plugs that could be removed for cleaning access, see sketch. These were very difficult to remove. The nozzle casing often had to be heated with a torch to loosen the plug. Steam conditions are 350 psig and 750 F.

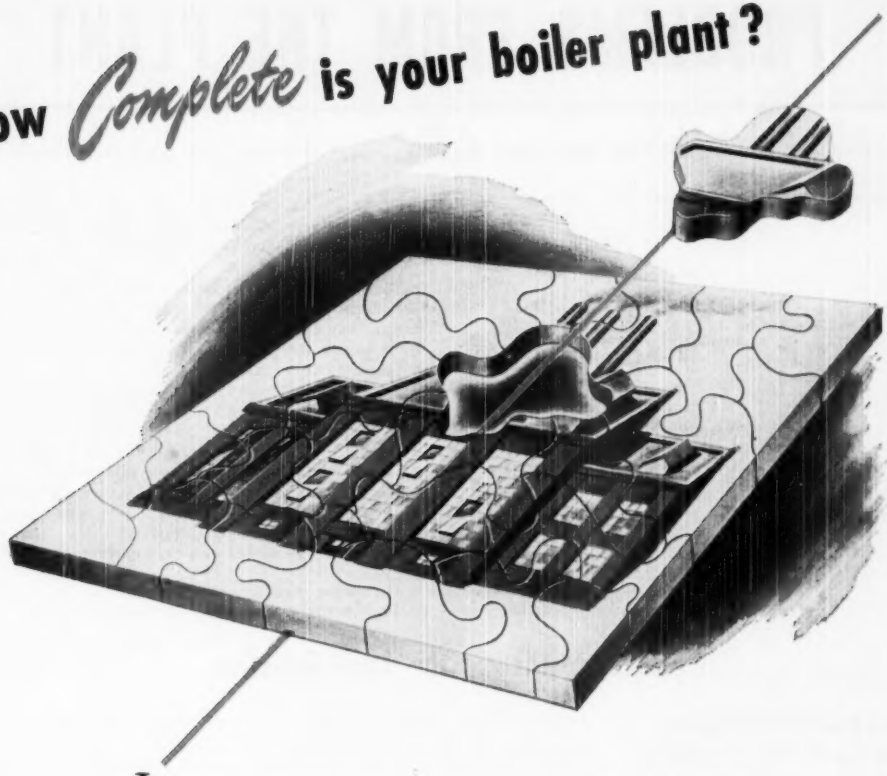
We substituted a nipple and gate valve for the plugs, as suggested by the sketch. Now, all we need do is take the element out of service, open the gate valve wide, and insert the cleaning wire and brush. This requires no tools and can be done quickly.

VINCENTE ALDAPE C
Monterrey, Mexico

HOW ABOUT YOUR IDEAS?

POWER pays $20 for each item published in this department on problems in design, operation and maintenance. Your manuscript need give only the facts, with sketches in pencil. We'll dress it up as needed for our readers.

How *Complete* is your boiler plant?



Insofar as mechanical equipment is concerned, a boiler plant may be complete in every respect. However, completeness of equipment will not necessarily assure most efficient operation of the system. An adequate and well controlled program of boiler water treatment, too, is highly important. A water conditioning engineering service should be an integral part of your picture. We ask, "how *complete* is your boiler plant?"

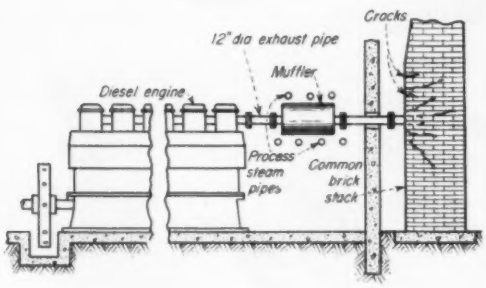
W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water conditioning problems relative to boiler feedwater . . . cooling water . . . air conditioning . . . industrial waste treatment. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical. Whatever your particular water conditioning requirements, our staff of engineers is ready to serve you. W. H. & L. D. BETZ, Gillingham and Worth Streets, Philadelphia 24, Pa. In Canada—BETZ Laboratories Limited, Montreal 1.

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

PROBLEMS FROM THE PLANT

THIS MONTH'S QUESTION: Why Does Diesel's Exhaust Line Leak and Brickwork Crack?



WE HAVE A 6-cylinder 14x17-in. 575-hp 2-cycle diesel driving a 400-kw generator. Our exhaust system gives us all kinds of misery. Sketch shows how it's connected.

Exhaust line runs horizontally from engine through muffler into a common-brick stack. Several 6-in. process-steam lines run above and below the muffler. All are well insulated. Exhaust line has flanges at engine, muffler and stack entrance. When engine was installed we were told exhaust line was designed to expand into stack.

Here's our problem. Flanges at engine and muffler tend to spring, allowing gases to escape to engine room. Besides, stack brickwork has cracked around exhaust inlet and several feet above it. We've tried tightening up flanges, coating brickwork with cement, but haven't had any luck.

Will POWER readers who've been around diesels give us sketches showing how to connect our exhaust system? Do steam pipes affect flanges in exhaust? Also, we'd like to know why flanges spread and brickwork cracks.—*AK*

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for: answers accompanied by sketches or photographs command additional pay

Readers Answer the April Question

Can I Correct Dripping From Cold-Storage Coils?

(This question from the April issue is followed by best answers from readers.)

I have a cold-storage produce room about 5x50 ft. Ceiling coils are 16 ft from the floor. I try to keep a temperature of 34 F. Room is piped with 1800 ft of 2-in. direct-expansion ammonia piping, arranged in two flat coils and supported from ceiling joists.

Load varies considerably at times as, for instance, when warm produce is moved in, doors opened, etc. Two manually operated expansion valves control the ammonia system. We are having trouble maintaining a constant frost line on the evaporating coils. When room temperature goes up a few degrees the coils start dripping, damaging containers.

Will any reader suggest a method of improving operation without resorting to water pans under the coils to carry off the drip?—WH

Check These Eight Points

TROUBLE IS CAUSED BY FAILURE of coils to boil off refrigerant rapidly enough to handle load and maintain required room temperature at all times. This is particularly true during period when hot goods are brought in with doors open.

WH does not state coil evaporating pressure, nor size or capacity of expansion valves. To carry room temperature of 34 F with ceiling coils and natural-air circulation requires evaporating temperature of 24 F; this is a difference of 10 F between room air and evaporating ammonia. Corresponding evaporating pressure is 37.9-psi gage. A somewhat closer temperature difference is obtained with more pipe surface. This is common practice, often followed where high humidities are desirable or needed to prevent dehydration of stored foods.

With a constant coil temperature of 24 F, coils do not drip because water freezes at 32 F. Try the following procedure in searching for possible causes. In some instances, most of the eight suggestions are needed to locate the trouble, while in others, only a few will lead to the solution.

1. Determine whether expansion valves are partly plugged with some kind of foreign matter. Generally, by opening valve wide for a few seconds, any obstruction lodged in valve ports or passage is blown through into evaporator.

2. Are valves actually expansion valves or just ordinary ammonia globe valves, installed by mistake?

3. Is liquid line between supply source and evaporating coils large enough to supply maximum evaporator needs, without excessive pressure drop? By installing pressure gages close to the expansion valve and in liquid line to evaporator, drop can be checked. Or friction tables can be used.

4. Where a mixture of litharge and glycerine paste is used on pipe and fitting joints, particularly in small pipes, paste may collect inside fittings. A hard ring may form and reduce net area of pipe 50% or more. This causes trouble in many installations.

5. Burrs formed at end of small liquid lines by pipe-cutting tools reduce effective area. Ends of all pipe should be reamed with a suitable reamer before pipe is erected. Up-end all pipe sections and tap them with a hammer to remove sand and dirt before installing.

6. It may be necessary to place a pressure gage on suction outlet of coil to measure evaporating pressure. Use a thermometer to find suction-gas temperature. If coils operate at high superheat, this indicates they have a reduced liquid supply and are not developing tonnage required.

7. System must be fully charged with ammonia. Unless liquid receiver has a gage glass, there is no positive way of telling whether system is fully charged.

MEET YOUR REQUIREMENTS?

A. This Tank Type Exchanger is representative of SK's complete line of Oil Coolers and Heaters, Air Coolers, Heat Exchangers and Evaporators.

B. This Electronic Rotameter is one of numerous types and sizes developed by SK since 1931 when we produced the first Rotameter in this country.

C. Standard SK Gear Pumps are available to handle most liquids free from solids in capacities up to 1000 gpm.

D. SK Valves, such as this Bleeder Check Valve, are backed by over 60 years of design and manufacturing experience.

E. Modern industrial usage of the jet dates from 1869 when Dr. Ernest Koerting patented a double tube steam injector. Today, the applications of the jet, one type of which is illustrated, are almost unlimited.

W

...know that's difficult to determine without knowing more about the equipment—the operating characteristics, capacities, the sizes and types available and similar data.

It is for that reason that we stress the availability of our complete *engineering* and *manufacturing* service and point out to you that our experienced engineers may help solve your problem just as they did for . . .

. . . a power engineer who wanted to reduce the pressure and superheat the steam from a high pressure steam source for use in low pressure turbines. A *specially engineered* Reducing and Desuperheating Valve, not shown, solved his problem.

. . . a manufacturer of fine tobaccos who wanted to record the rate of flow of tobacco casing for close formula control. Two *standard* Electronic Recording Rotameters, of the type illustrated, helped provide the product uniformity he wanted upon.

. . . numerous other manufacturers who found that an SK product, *of standard design or specially engineered*, supplied the answer to their needs.

Why not avail yourself of our engineering experience. Let us help determine how SK equipment can best be applied for you.

Bulletins on all SK products are available upon request.

SCHUTTE and KOERTING Company

Manufacturing Engineers

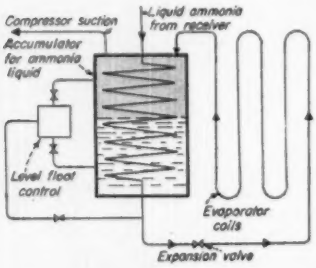
1160 THOMPSON STREET • PHILADELPHIA 23, PA.

JET APPARATUS • HEAT TRANSFER EQUIPMENT • STRAINERS • CONDENSERS AND VACUUM PUMPS • GAS PURIFICATION EQUIPMENT • ROTAMETERS • FLUID INDICATORS • BALANCED VALVES • SPRAY NOZZLES AND ATOMIZERS • GEAR PUMPS • CENTRIFUGAL BLOWERS

If not, gas is passing the expansion valves.

8. Evaporator capacity may be reduced by oil carried over from the compressor. All coils should have oil drain valves near suction outlet. Because oil is a nonconductor it reduces heat-absorbing capacity. Coils containing oil are likely to fill with liquid because evaporating rate is too slow. Liquid may slug over to compressor.

C T BAKER *Atlanta, Ga.*



Install Accumulator

WITH MANUALLY OPERATED expansion valves, close control is needed to prevent too great an opening. As refrigeration load increases evaporator coils may flood with comparatively warm liquid, thawing frost and causing drips. Closeness of room temperature to freezing point is the reason frost thaws.

I suggest installing an accumulator, see sketch. It precools liquid ammonia to nearly evaporator temperature before it reaches expansion valve. Accumulator also prevents liquid ammonia carrying over to compressor.

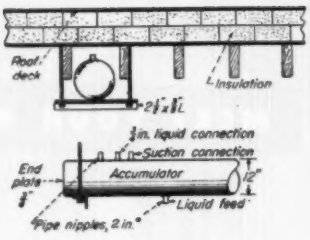
C WERDERITCH *Albert Lea, Minn.*

Unit Blowers Are Tiptop

LOAD IS NOT MET by hand-operated expansion valves. *WH* should open expansion valves more if he knows load is increasing and he has sufficient capacity. This may not be easy, but I would suggest closer watch of room and more manipulation of expansion valves. If cold-storage room is some distance from machine room or expansion valves, he can use a recording thermometer to advantage. He might also lower room temperature before loading.

Before buying drip pans, I suggest changing system to air-blower type; it is more adaptable to his service. If he buys unit blowers, he should space fins on tubes at least four to the inch. I have replaced several overhead systems with unit blowers and been completely satisfied.

GEORGE GRIFFEL *New York, N.Y.*



Use Flooded Coils

WH's PROBLEM IS TYPICAL of most flat direct-expansion coils supported from ceiling.

Liquid ammonia fed to coil flows along bottom of pipes, covering only a small area; rest of coil is filled with gas. Under these conditions only a small percentage of pipe area is actually wet with evaporating liquid. Saturated gas absorbs little heat; so the temperature changes rapidly in sections of coil containing little liquid.

This condition causes frost line to come and go, with changes in load or slight adjustment of expansion valve. A thermostatic expansion valve would be an improvement over manual operation but would not entirely solve the problem.

Sketch shows a simple method of converting coils into a flooded system. Bottom of accumulator should be placed 2 in. above centerline of coils if possible. Liquid drain to coils should be 2 in. dia even though piping may be 1¼ in. This is most important, otherwise gas generated at this point prevents free flow of liquid to coils.

Liquid is fed direct to top of accumulator. Gas generated in cooling the liquid to evaporating temperature passes direct to suction line, instead of through hundreds of feet of coil.

As entire coil is filled with liquid, at evaporating temperature, every square foot of surface absorbs equal amounts of heat, greatly increasing system efficiency. If coils accumulate frost rapidly, provide a hot gas line, connected for defrosting.

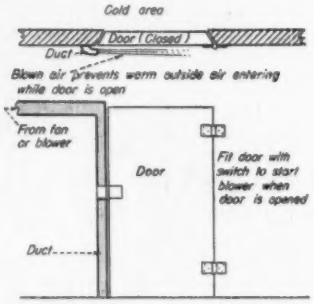
My experience shows that a heat-transfer coefficient of 1.5 Btu per sq ft F hr should be used with old flat-type coil. Flooded system coefficient is about 2.5 Btu per sq ft F hr. Figures are based on gravity circulation of surrounding air, and coils covered with light, dry frost.

HARVEY WELCH *Baldwin, N.Y.*

Air Curtain Does the Job

WH's PROBLEM EVIDENTLY has two causes: excess of warm air entering while door is open for loading, and warmth of the produce itself. Assuming that adjustment of expansion valves does not prevent dripping, and that coils cannot be relocated along the sides of room, he must find some way of keeping warm air out of the room. There is little chance of doing much about heat in the produce, outside of precooling.

One possible solution is an air curtain across the doorway, as in sketch. A small duct alongside the frame with a


Cold area
Door (Closed)
Duct
Blown air prevents warm outside air entering while door is open
From fan or blower
Door
Fit door with switch to start blower when door is opened
Duct

fan to supply a barrier of fast-moving air will prevent warm outside air from mixing with cool inside air. Duct and fan could be installed at low cost. Success of scheme depends upon door size and location, not mentioned by *WH*. We use air curtains extensively for separating dining and kitchen compartments, but have never applied one in a situation like this. A makeshift experimental installation might be wise, at first.

D H NOBLE *Wilmington, N. C.*

Replace Expansion Valves

TO KEEP FROST tightly frozen on his evaporator pipes while room temperature rises several degrees above melting point, *WH* must constantly hold a saturated or near-saturated condition in coils. Also, keep suction pressure reasonably low.

To do this with manually operated expansion valves would be inefficient, if not impossible. Whenever a door was left open long, or a load placed in cooler, expansion valves would have to be opened wider, then set back when room was cooled to desired temperature. Melting of frost on pipes nearest return line would probably start before extra liquid evaporated. Also, with valve open too wide or too long, liquid might flood back to compressor.

Manual expansion valves are poor regulators of superheat. *WH* should replace his with thermostatic expansion valves having power assemblies properly charged for operating conditions in his

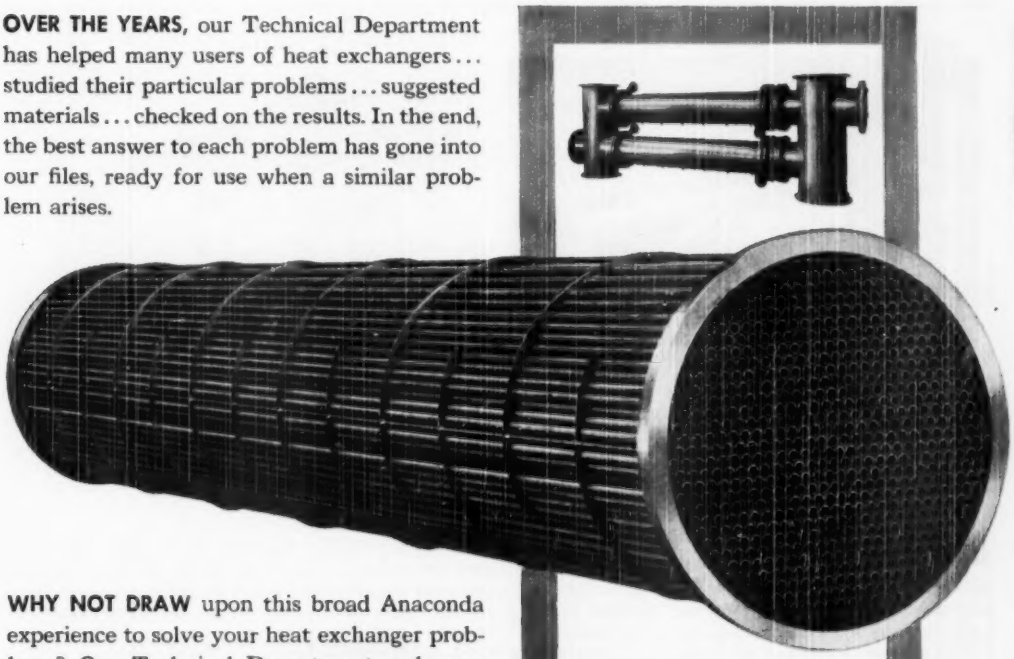
(*Continued on page* 160)

Is your heat exchanger tube and sheet problem

Different? Tougher?

It may seem so to you—but it may not be so to us!

OVER THE YEARS, our Technical Department has helped many users of heat exchangers... studied their particular problems... suggested materials... checked on the results. In the end, the best answer to each problem has gone into our files, ready for use when a similar problem arises.



UPPER PHOTO shows Adams two-shell, single stage aftercooler designed to control temperature of compressed air and to condense water and oil vapors present. The condensate is removed by a separator. Built by R. P. Adams Company, Inc., Buffalo, N. Y.

LOWER PHOTO shows tube bundle for aftercooler. ANACONDA Arsenical Admiralty Tubes, Muntz Metal Tube Sheets and Brass Baffles.

WHY NOT DRAW upon this broad Anaconda experience to solve your heat exchanger problems? Our Technical Department welcomes the opportunity to place it at your service. If you don't already have a copy, let us send you "ANACONDA Tubes and Plates for Condensers and Heat Exchangers." Just ask for Publication B-2. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Limited, New Toronto, Ont.

AD118

For efficient heat transfer **ANACONDA®**

HEAT EXCHANGER TUBES

TECHNICAL BRIEFS

ENGINEERING DEVELOPMENT HERE AND ABROAD DIGESTED FOR BUSY POWER MEN

REVIEWED IN THIS ISSUE

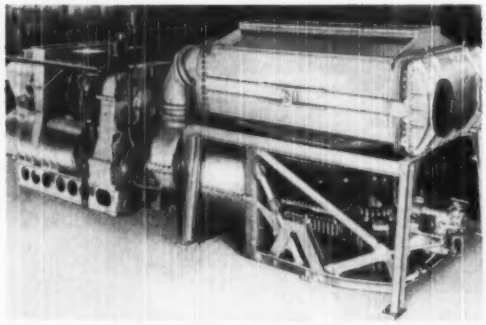
GAS TURBINES: A Gas Turbine for Coal-Burning Locomotive Service • A 4000-Hp Gas-Turbine Locomotive for Passenger Service

HYDROELECTRIC POWER: Underground Hydroelectric Plants • Man Develops Colorado River • Pacific Gas & Electric Spends $10 to $15 Million a Month on New Construction • When Completed Big Creek (San Joaquin) Project to Generate 2¾ Billion Kwhr

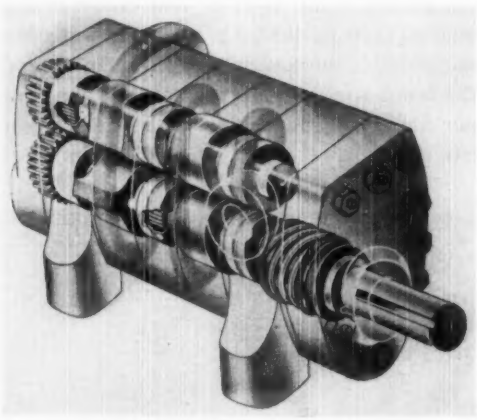
FLUIDS AND PUMPING: The Berry Hydraulic Transmission • Standards of Performance for the Heat Pump • Comparative Costs of Fabrication of Industrial Piping • Gaskets and Bolted Joints

WATER TREATMENT: Demineralization as Compared With Evaporation of Makeup • Water Treatment for Modern Electric Utility Plants • Prevention of Deposits in Closed Feedwater Heaters and Economizers

Directions for ordering papers are given on page 140



1 Coal-fired 4100-hp gas turbine's test runs used oil combustors in air-stream pipes from high-pressure discharge



2 Hydraulic motor design for power transmission develops constant torque at constant pressure regardless of speed

Gas Turbines

A GAS TURBINE FOR COAL-BURNING LOCOMOTIVE SERVICE, *by W B Tucker, Allis Chalmers Mfg Co.* A year ago the author presented a paper on the design of a locomotive gas turbine being manufactured by his company. This supplementary paper describes some of the manufacturing problems.

The gas turbine described, Fig. 1, is for locomotive service and will receive its heat energy from coal. To obtain high turbine-stage efficiency the blades were designed to give radial-flow stability of the gases. This requires that the stationary and moving blades have rather extreme section and chord angle changes throughout their length.

After the port (gas flow) section is finished this portion of the blade must be positioned in relation to the root section before machining the root section. A special Jones and Lamson comparator assists in properly positioning the blade to avoid any unbalance.

For shop testing of the finished unit, Fig. 1, an oil combustor was placed in each of the two air-stream pipes connecting the high-pressure discharge manifold of the regenerator with the two inlet nozzles of the turbine. Regenerator is shown mounted above the turbine and compressor on a temporary shop support. In the actual installation, side walls of the locomotive cab will support this component.

Main generator, consisting of four dc units, shows to the left in Fig. 1. The four electrical auxiliary generators mount above the main generator. *MWP paper. No number.*

A 4000-HP GAS-TURBINE LOCOMOTIVE FOR PASSENGER SERVICE, *by T J Putz, Westinghouse Electric Corp.* The author's company has built a gas-turbine locomotive solely for experimental work. They feel an extensive development program lies ahead before this form of motive power becomes a commercial product capable of economical service.

The locomotive is being built in one unit, arranged for single-end operation, and will be carried on four 2-axle swivel trucks giving a B-B-B-B wheel arrangement. All eight axles will be equipped with traction motors, making 100% of the total weight available for adhesion.

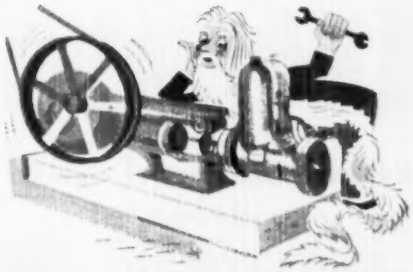
Main power supply comes from two 2000-hp simple open-cycle gas-turbine generator sets, side by side in the locomotive cab, with a center aisle. Steam for train-heating purposes will be provided by two boilers with a total steam capacity of 5000 lb per hr.

The gas-turbine generators consist of a compressor, turbine, gear-reduction unit and generator, all mounted on a common bedplate. The assembly mounts in the locomotive on a 3-point suspension to prevent carrying the weaving of the main locomotive frame to the turbine equipment.

Air for the gas turbine enters through the cab roof and goes by ducts to the compressor inlet. These ducts are insulated for noise compression. Air then

For thousands of years
Orientals have known ramie
as the long-lasting fibre . . .

Now . . . Johns-Manville
makes ramie fibre into
the long-lasting packing . . .



That's why *NAVALON* cuts packing costs to the bone . . .

IF YOU NEED A PACKING for reciprocating service that can take punishment and *last* . . . against fresh or salt water, brine, cold oil, and other cold liquids . . . try Navalon.

Navalon's long-lasting properties are inherited directly from ramie—a fibre that has been known for thousands of years for its strength and its rot-resisting qualities.

Because these long-lasting qualities of ramie—its high tensile strength and its rot-resistance—have been retained in Navalon, and because of a special Johns-Manville process that imparts unique lubricating properties, Navalon is consistently out-performing other packings in cold liquid service. In plant after plant, Navalon is standing up where other packings fail . . . reducing down time . . . and cutting packing costs to the bone!

If you have a tough packing problem, we suggest that you try Navalon. You can get it through your local packing distributor—or if you would like further details, write for folder PK-32A. Just fill in and mail the coupon below.

Johns-Manville
PACKINGS & GASKETS

Johns-Manville
Box 290
New York 16, N. Y.

Please send me your folder on Navalon Packing (PK-32A).

Name_____

Company_____

Address_____

City_____ State_____

(POW-7)

flows through the 23-stage axial-flow compressor where its pressure goes up about fivefold. It then passes into twelve combustors, where fuel is mixed and burned to raise the mixture's temperature to 1350 F before entering the 8-stage gas turbine.

About two thirds of the power developed is absorbed in driving the compressor. The remainder is available for useful work. The combustors, fitted with air-atomizing-type nozzles, can burn various liquid fuels from light diesel oil to heavy bunker feed. With heavier oils, the unit starts and stops with a light fuel supplement to the train-heating boilers. It is hoped this experimental locomotive will help determine fuel specifications for a suitable, heavy gas-turbine fuel. *MWP paper. No number.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from one of the following sources unless otherwise noted:

Midwest Power Conference, annual meeting, Chicago, Ill. April 5-7, 1950. Papers are identified by initial MWP. Obtainable in proceedings ($3) from E R Whitehead, Secy, Illinois Institute of Technology, 3300 Federal St, Chicago, 16, Ill.

American Society of Civil Engineers, Pacific Coast meeting, Los Angeles, Calif. April 26-28, 1950. Papers are identified by initials ASCE. Available from ASCE, 29 W 39th St, New York 18, N. Y.

Oil Heat Institute of America, 27th annual convention, Philadelphia, Pa., April 24-28, 1950. Papers are identified by initials OHI. Available from OHI, 6 E 39th St, New York 16, N. Y.

Hydroelectric Power

UNDERGROUND HYDROELECTRIC PLANTS, *by Joseph D Lewin, Board of Water Supply engineer, New York City.* Sixty underground hydroelectric plants have been built or are under construction in the world, since the Buchbergmuehle plant in Germany went into operation in 1907. These plants have a total capacity of over 7,000,000 hp. The rapid growth of this type of plant indicates that it is economical to build and operate.

It seems there are no geographic, climatic or topographic limitations on underground power plants. From above the Arctic Circle, where the Swedish Porjus and Harspranget plants and the Russian Niva plant have been built, to southern Italy, where the Flumendosa plant is situated, and from the Sulak in the eastern Caucasus to the Bromat and Baton plants in France, underground plants spot the globe. Even south of the Equator, in Peru and Australia, there are such developments. Underground power plants have been built at all elevations, from 7000 ft above sea level to the Niva plant just south of Murmansk, which discharges below sea level into Kandalaska Bay. The plants range in size from 31 hp in Friedigen, Germany, to a 2,800,000-kw development in several plants on the Snowy River in Australia.

Neither do considerations of hydrostatic head affect underground power plants. They range from the 17.7-ft-head plant at Friedigen to the 3540-ft-head development at Tyin in Norway. Water quantities vary from the 15 cfs at Foce Ponale in Italy, to the 14,200-cfs plant at Harspranget in Sweden.

These plants are built in all types of rock. Some are built in hard, sound rocks like the granites of Sweden, requiring practically no support; a few have been built in badly fissured, even disintegrated rocks, which required substantial and nearly continuous roof supports.

From the operational point of view, there are run-of-the-river and storage-fed plants; base-load and peak-load plants. There are even two pumped-storage plants—the Swiss Palue and the Italian Coghinas. No matter how different these plants are in size, location, layout and operation, they have one thing in common. They represent the most economical solution for developing power resources at the particular site.

Although underground hydro plants are more immune to aerial bombardment than surface plants, this advantage was not given much consideration since the majority were constructed before development of strategic bombing during the last war. The original decision to place plants underground was primarily an economical one.

An analysis shows that costs are as much as 40% less than conventional surface developments. Most of the savings result from shorter developments, elimination of penstocks and valves, and savings in tunnel linings. Rock is utilized as a structural material and made to carry loads. Underground operating expense is less. There is no painting, no roofing, no heating, and only a small depreciation charge. Excavation cost is 90% of the investment. Underground power houses are adapted to architectural treatment. The domed structures are suited to indirect lighting and air conditioning.

The seemingly paradoxical fact that underground developments are cheaper than surface plants can be attributed to more economical methods of excavating rock in Europe. Based on prevailing American labor costs, European tunneling methods can reduce the cost of rock excavation by as much as 60%. *ASCE paper.*

MAN DEVELOPS COLORADO RIVER, *by E A Moritz, U. S. Bureau of Reclamation.* The states of the Colorado River Basin have, through an interstate compact, now the law of the land, accorded water for domestic and agricultural use priority over all other. Irrigation alone could not build these works, but by taking in a paying partner, "power," costs can be repaid.

Geographically, and by interstate pact, the Colorado River Basin is separated into the Upper and Lower Basin by the natural mountain divides through Lee's Ferry on the river above Grand Canyon. The Upper Basin drainage area supplies 90% of the net virgin water, but by compact the Upper Basin must not cause the river at Lee's Ferry to be depleted below an annual average of 7½-million acre-ft. In the Upper Basin, 1,350,000 acres of agricultural land are under irrigation; in the Lower Basin, 1,860,000 acres. Five major cities, Phoenix, Denver, Los Angeles, San Diego and Salt Lake City, look to the Colorado River and its tributaries for water supply.

Of 38 sites on the Colorado River and its tributaries above Hoover Dam that the Bureau of Reclamation has investigated, it has submitted for review 12 additional dams, reservoirs and power plants, whose construction is estimated to cost over a billion dollars. Glenn Canyon Dam is the largest, to be 565 ft high and form a reservoir in southern Utah of 26-million acre-ft capacity, nearly as big as Lake Mead above Hoover Dam. Engineers for the Bureau estimate that the Basin's potential hydroelectric power of 5-million kw is but half developed, but that there is water enough in the river for full development of economical irrigation opportunities and major hydroelectric development. *ASCE paper. No number.*

PACIFIC GAS & ELECTRIC CO SPENDING $10 TO $15 MILLION A MONTH ON NEW CONSTRUCTION, *by H W Haberkorn, Pacific Gas & Electric Co.* The ¾-billion-dollar postwar expansion program calls for $10 to $15 million per month for new construction during the 6-year period 1946 to 1951. It has added 300,000 kva of hydro power and by the end of 1951 will have added 1,000,000 kva of steam electric power to the com-

(*Continued on page* 170)

NIAGARAS of CONDENSATE

can be handled with ARMSTRONG *Compound* STEAM TRAPS

WHERE there is a lot of condensate to handle in a hurry, Armstrong Compound Steam Traps fill the bill to perfection. They will take sudden as well as normal loads in stride — give you dependable, automatic drainage of purifiers, separators, de-superheaters, flash tanks, headers, hot water heaters, continuous blowdown systems and process equipment.

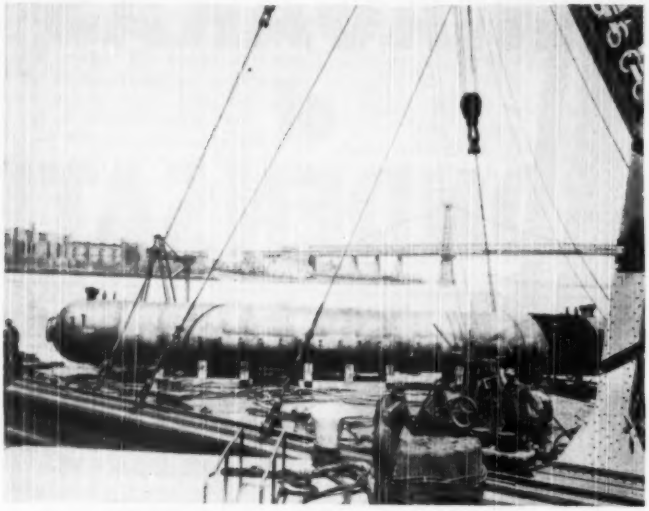
In these traps a standard Armstrong inverted bucket trap mechanism actuates a piston-operated discharge valve with a much larger orifice than could possibly be considered in an ordinary trap. The result is a thoroughly dependable trap which is surprisingly small and compact in relation to its capacity. For full details call your Armstrong representative or write: ARMSTRONG MACHINE WORKS 812 Maple Street, Three Rivers, Michigan.

THE ARMSTRONG STEAM TRAP BOOK includes essential data on Compound Traps as well as traps for general service. You are welcome to a copy — no obligation. Write today.

ARMSTRONG STEAM TRAPS

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS



World's Largest Boiler Gets Its Drum

Specially rigged flat cars carried this 60-ft-long, 6-ft-dia, 116-ton steam drum for the world's largest boiler from the Barberton, Ohio plant of Babcock & Wilcox Co, to a lighter along the Jersey coast. Final transfer was made to Hudson Ave generating station of Consolidated Edison Co of New York by means of trailer trucks

COMING EVENTS

July 17-19—Universal Craftsmen Council of Engineers, 46th annual convention, Hotel Statler, Boston, Mass. Dudley G Kimball, chairman, 55 Clifton St, Boston 25, Mass.

August 15-19—National Association of Power Engineers, 49th annual power show and convention, Hotel Jefferson, St. Louis, Mo. A F Thompson, secy, 176 W Adams St, Chicago, Ill.

Sept 19-21—American Society of Mechanical Engineers, fall meeting, Hotel Sheraton, Worcester, Mass. O B Schier, secy, ASME, 29 W 39th St, New York 18, N. Y.

Sept 26-29—Association of Iron & Steel Engineers, Cleveland, Ohio. T J Ess, managing director, 1010 Empire Bldg, Pittsburgh 22, Pa.

Oct 2-5—Technical Assn of Pulp and Paper Industries, engineering meeting, Netherland Plaza Hotel, Cincinnati, Ohio. R T Bingham, TAPPI, 122 E 42nd St, New York, N. Y.

Oct 23-27—American Institute of Electrical Engineers, fall meeting, Skervin Hotel, Oklahoma City, Okla. H H Henline, secy, AIEE, 29 W 39th St, New York 18, N. Y.

Can Coal Products Match Natural Gas, Oil?

Pricewise, natural gas, delivered wholesale, will have to double—at least, before science can produce from coal a fuel gas competitive with natural gas. Likewise, there is little chance of any manufactured gas competing with fuel oil at present price levels.

Dr John D Foster, Battelle Institute fuels expert, and Dr Richard J Lund, engineering economics authority, shared this feeling in a paper they presented recently before the American Institute of Chemical Engineers in Cleveland.

This study lends more evidence to support the opinion of many technologists and individuals connected with the coal industry. They argue that the best way for coal to maintain and expand its markets is to join with the public utility industry in promoting greater use of electricity.

Of all the manufactured gases, producer gas seems closest to competitive possibilities. In fact, it may be on the threshold of a comeback. It cost less in heating value in 1949 than light distillate fuel oils and only slightly more than heavy fuel oils.

Further, it assures a steady supply of fuel gas. This could be very important if interruptions of natural gas to industry are likely to occur because of pipeline breaks or peak domestic demands during severe weather. It could also prove important if the long-term supply of fuel oil became uncertain. With future developments of improved techniques for using low-cost waste coal, producer gas may be made for as low as 25 to 30c per million Btu.

Foster and Lund believe there is a likelihood of developing through research a cheaper manufactured gas of 300 to 500 Btu per cu ft as a substitute for natural gas where it is not available or where low Btu producer gas is not satisfactory.

Several fuel gases are made from coal. Producer gas, the cheapest, has a heating value of about 150 Btu per cu ft; water gas, 300 Btu; carbureted water gas, 530 to 550 Btu; coke oven gas, 600 Btu; Lurgi gas, 450 Btu.

Points that must be considered, in addition to current economics, are supply situations and trends in costs of competitive fuels. Coal, of course, has abundant reserves. Proven domestic reserves of petroleum are enough for only 12 years at the present rate of consumption. Imports and new discoveries, however, will undoubtedly prevent critical peace-time shortages for many years to come. What effect such sources will have on costs remains to be seen.

Proven deposits of natural gas are huge, around 30 times our annual consumption. But transportation to the customer involves costly pipelines and dedication of large portions of the gas reserves to supply markets for as long as 20 years in the future.

For more news, turn to page 202

A Nalco Representative checks over one of "his" plants with the plant engineer. Specialized training and experience make Nalco men your staff consultants on all water treating problems in your plant.

WATER TREATMENT SECURITY

for Your Plant with

THE *Nalco* SYSTEM

WATER treatment security for your plant—as Nalco interprets it—means that aside from routine testing, control, and required inspections, you can stop worrying, *permanently* about steam purity, scale, corrosion, or other difficulties which might be caused by faulty water treatment procedures and chemicals. The Nalco System goes beyond a cursory survey and an order for chemicals. Your plant becomes the personal responsibility of your Nalco Representative; and he is backed by the entire facilities and personnel of the National Aluminate Corporation — nearly 600 skilled individuals who believe that effective industrial water treatment is up to Nalco standards only if each Nalco System plant is getting exactly the right treatment for the specific water, equipment and operating conditions involved. A postcard or letter will bring you further details on Nalco Water Treatment Security... Check on it today.

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem, Limited, Burlington, Ontario

THE *Nalco* SYSTEM . . . Serving Industry through Practical Applied Science

JENKINS PRACTICAL PIPING LAYOUTS

53

How to plan

DISTRICT STEAM BUILDING CONNECTIONS

Producing steam at a central station for use in nearby buildings is a rapidly expanding business. Although purchased steam may cost slightly more per pound than steam produced by the consumer, it offers many compensating advantages. These include low first costs for the building by the elimination of a boiler plant, a clean building, and low maintenance costs.

The system illustrated here shows the connections within a building where steam is supplied at approximately 100 lbs. pressure. It is equipped with two sets of meters. One is for measuring steam used for the hot water tank and general year-round industrial purposes. The other is for measuring steam used for heating purposes only. Low pressure steam is provided by using pressure-reducing valves. Pressure-actuated, electrically-operated audible alarms, permitted by the pressure piping code, are recommended in this layout after each reducing valve. All automatic valves are provided with three by-passes to avoid costly service interruptions in the event of their failure.

Varying pressures are used by most installations, and for this reason a flash tank is provided where all condensate is returned and combined for possible reuse or discharge. Some of the heat still contained in the condensate is recovered as it passes through the hot water supply preheater.

Iron Body Bronze Mounted Outside Screw and Yoke Valves with Rising Spindles, Jenkins Fig. 204, are recommended for use in the distribution mains of the high pressure lines. They are ruggedly constructed to withstand tough steam service and are fitted with a solid wedge and renewable bronze seat ring. Packing box is liberal in depth, and is packed with high pressure asbestos material, lubricated and graphited for long service. Bronze Spindle ring is deeply chamfered to permit back-seating so valve can be repacked under full pressure.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from Jenkins Catalog. *It's your best assurance of lowest cost in the long run.* Despite their extra value, you *pay no more* for Jenkins Valves. Jenkins Bros., 100 Park Avenue, New York 17. Jenkins Bros., Ltd., Montreal. Sold through reliable Industrial Distributors everywhere.

Reserve your copy of
NEW BOOK OF PIPING LAYOUTS — NOS. 26 to 50

A new book of Jenkins Practical Piping Layouts — Nos. 26 to 50 — is in preparation. Mail coupon to get your copy when ready.

Fig. 204
Solid Wedge, Rising Spindle, Outside Screw and Yoke
IRON BODY GATE VALVE

250 Pounds Steam
500 Pounds Non-Shock
Cold O.W.G.

JENKINS BROS., 100 Park Avenue, New York 17, N. Y.
Reserve book of Piping Layouts—26 to 50—for:

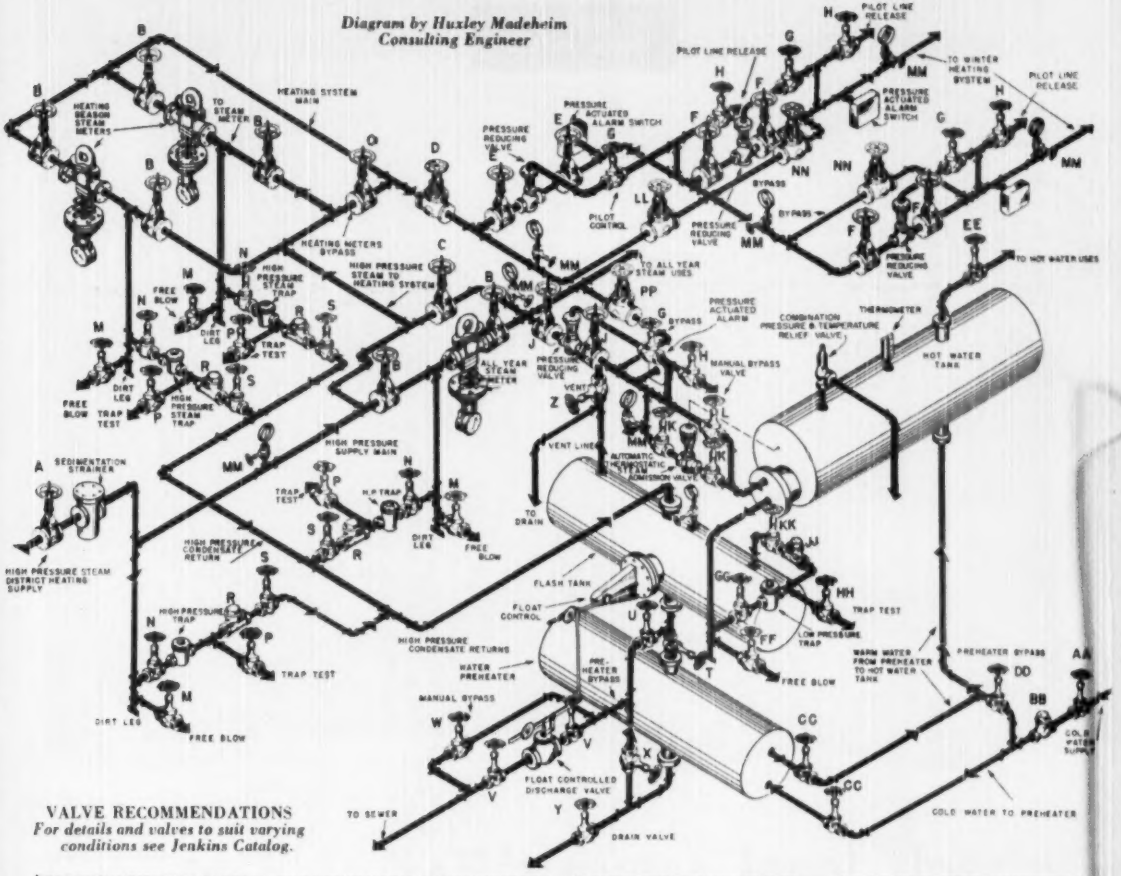
Name

Company

Address

DISTRICT STEAM BUILDING CONNECTIONS

Diagram by Huxley Madeheim
Consulting Engineer



VALVE RECOMMENDATIONS

For details and valves to suit varying conditions see Jenkins Catalog.

Code	Quan.	Jenkins Valves	Service
A	1	Fig. 204 I.B.B.M. Gate	Service Shutoff
B	6	Fig. 204 I.B.B.M. Gate	Meter Disconnects
C	2	Fig. 204 I.B.B.M. Gate	Meter Bypass
D	1	Fig. 923 I.B.B.M. Globe	Heating Main Shutoff
E	2	Fig. 204 I.B.B.M. Gate	First Pressure Reducing Valve Shutoff
F	4	Fig. 651 I.B.B.M. Gate	Second Pressure Reducing Valve Shutoff
G	4	Fig. 703 Bronze Needle	Pressure Reducing Valve Pilot Control
H	4	Fig. 950 Bronze Globe	Pilot Line Drain
J	2	Fig. 204 I.B.B.M. Gate	Steam Shutoff to H.W. Tank
K	2	Fig. 370 Bronze Gate	Thermostatic Valve Shutoff
L	1	Fig. 956 Bronze Globe	Thermostatic Valve Bypass
M	4	Fig. 956 Bronze Globe	High Pressure Condensate Free Blow
N	4	Fig. 280 Bronze Gate	High Pressure Trap Shutoff
P	4	Fig. 950 Bronze Globe	High Pressure Trap Test
R	4	Fig. 962 Bronze Swing Check	Prevent Condensate Backflow
S	4	Fig. 280 Bronze Gate	Condensate Return Shutoff
T	1	Fig. 47 Bronze Gate	Water Preheater Condensate Shutoff
U	1	Fig. 47 Bronze Gate	Water Preheater Bypass
V	2	Fig. 47 Bronze Gate	Float Valve Shutoff

Code	Quan.	Jenkins Valves	Service
W	1	Fig. 106-A Bronze Globe	Float Valve Bypass
X	1	Fig. 47 Bronze Gate	Condensate Shutoff from Float Valve
Y	1	Fig. 106-A Bronze Globe	Water Preheater Condensate Drain
Z	1	Fig. 703 Bronze Needle	Flash Tank Vent
AA	1	Fig. 47 Bronze Gate	Cold Water Supply
BB	1	Fig. 352 Bronze Swing Check	Cold Water Supply
CC	2	Fig. 47 Bronze Gate	Water Preheater Shutoff
DD	1	Fig. 47 Bronze Gate	Water Preheater Shutoff
EE	1	Fig. 47 Bronze Gate	Hot Water Supply
FF	1	Fig. 106-A Bronze Globe	Low Pressure Condensate Free Blow
GG	1	Fig. 370 Bronze Gate	Low Pressure Trap Shutoff
HH	1	Fig. 106-A Bronze Globe	Low Pressure Trap Test
JJ	1	Fig. 92 Bronze Swing Check	Prevent Condensate Backflow
KK	1	Fig. 370 Bronze Gate	Low Pressure Condensate Shutoff
LL	1	Fig. 923 I.B.B.M. Globe	Pressure Reducing Valve Bypass
MM	7	Fig. 703 Bronze Needle	Pressure Gage Control
NN	2	Fig. 923 I.B.B.M. Globe	Pressure Reducing Valve Bypass
PP	1	Fig. 923 I.B.B.M. Globe	Pressure Reducing Valve Bypass

COPYRIGHT, 1930 — JENKINS BROS.

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

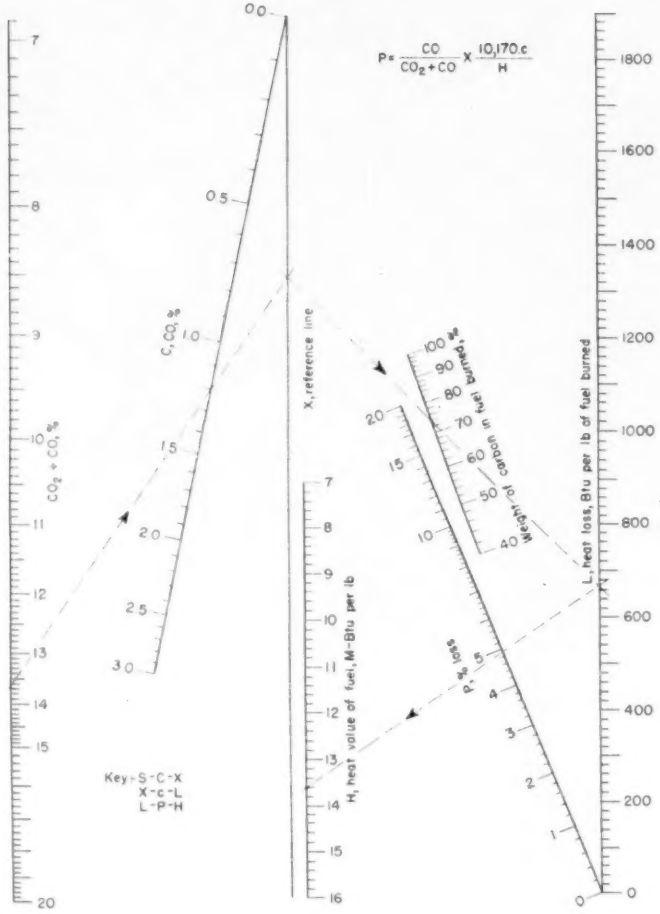
A **Use the right type valve for the service**

B **Place valves correctly in the line**

C **Choose Jenkins for lifetime economy**

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864
TRADE JENKINS MARK

Number 217


$P = \frac{CO}{CO_2 + CO} \times \frac{10{,}170\,c}{H}$
C, CO_2 %
$CO_2 + CO$, %
X, reference line
H, heat value of fuel, M-Btu per lb
Weight of carbon burned in fuel burned, %
P, % loss
L, heat loss, Btu per lb of fuel burned
Key-S-C-X
X-c-L
L-P-H

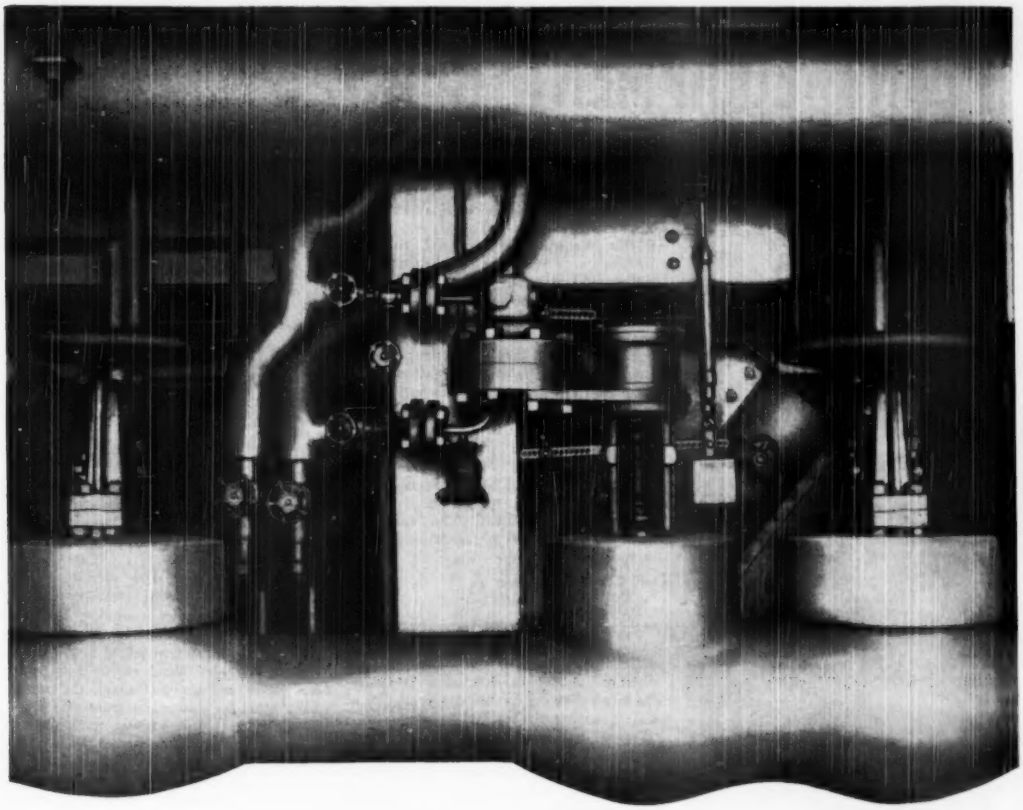
Loss From Unburned Carbon Monoxide

► WHEN ONE POUND of carbon burns and produces only CO, it has fallen short, by about 10,170 Btu, of developing its full heat energy of about 14,544 Btu. Knowing the flue-gas analysis and percentage of carbon in the fuel actually burned, total heat loss can be figured by the nomogram above. Find heat loss in terms of Btu per lb fuel, or as percentage of total heating value.

Example: Boiler has a flue-gas analysis of 12.4% CO_2, 1.2% CO while it burns 0.74 lb of carbon per lb of fuel. Find the heat loss and its percentage of fuel heating value, which is 13,600 Btu per lb.

Follow the key in the nomogram, first adding CO and CO_2 to find intersection with the reference line. Then read heat loss on the right-hand *L* scale of 665 Btu per lb of fuel burned. By laying straightedge from this value to fuel-heating value on scale *H*, find 4.9% loss at intersection with *P* scale.

BY JOHN F HYAM, *Sarnia, Ontario, Canada*



How to hold boiler water level closely

When you want to hold boiler water level within close limits, no matter how widely or rapidly loads change, depend on COPES Flowmatic—the simplest, most widely used flow-level type of feed control.

This industrial installation, for example, is on a 660-psi Riley Steam Generator rated at 225,000 pounds per hour. Loads constantly fluctuate 10,000 pounds per hour over a total range from 150,000 to 265,000 pounds per hour. Yet water level is held within plus-or-minus one inch at all times.

More than 1200 Flowmatic users like the coordination of influences from steam flow and water level to get the exact feed needed for close level control. They also like the ease with which plant personnel can handle all maintenance.

For a complete performance report on installation illustrated above, write for Bulletin 485.

NORTHERN EQUIPMENT CO.
701 Grove Drive, Erie, Pa.
BRANCH PLANTS: Canada, England, France, Austria, Italy. *Representatives Everywhere*

COPES
Headquarters for . . .
Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

PLANT EQUIPMENT NEWS

Published monthly as a service to readers

Your information center for new products to solve plant problems. Spot what you need, use handy cards to request more details

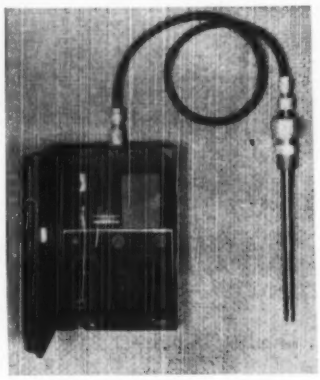
WATTMETER FOR SINGLE AND POLYPHASE CIRCUITS

P700. Known as Type AK-2, this new instrument allows taking measurements without interrupting service. Similiar in appearance to the conventional clamp-on ammeter, it makes use of a magnetic hook to surround the current-carrying conductor. Potential leads are connected as in a conventional single-phase wattmeter.

In measuring balanced power in a 3-phase circuit, two power leads are passed through the hook while potential leads are connected across both these wires. Through the use of a single dial switch a selection of any of six power measurement ranges is available; from 3- to 300-kw.

This wattmeter with its simple switching, direct-reading scale is introduced as a companion unit to the AK-1.

GE Co, Schenectady 5, N. Y.



LIQUID-LEVEL CONTROL **P762**

Designed to actuate a solenoid valve, magnetic contactor or other device requiring closing of an electric circuit, this control operates on the principle of a variable capacitor. It includes a control unit connected to a sensing element by a coaxial cable, which can be almost any length Sensing element consists of a porcelain-coated steel rod supported concentrically in a steel tube, vented top and bottom.

This element, when placed in liquid whose level is to be controlled, senses any change in capacitance due to rise or fall of liquid level. Change in capacity actuates a relay and indicating light through the action of an electronic tube in the control. Relay energizes a solenoid-operated valve or motor controller to start or stop liquid flow into the vessel.

There are no moving parts in the liquid, which may be either conducting or non-conducting. The sensing element operates in subzero or high-temperature liquids, in oils or acids, under high pressure or in open vessels, and will control within narrow or broad limits. It can be installed directly in an ammonia receiver, evaporator, heater, pressure vessel, or in any liquid column where a ball-float unit is used. It may be placed at an angle, in a vertical position, or several sensing elements may be used for a wide variation of level control. Differential between cutin and cutout points and liquid-level heights is adjusted by turning two knobs on the controller.

Thermo Instrument Co, Belmont, Calif.

UNIT HEATER **P726**

Smallest, suspended gas-fired unit heater, the *Cadet*, 25,000-Btu unit has two speeds, one for summer ventilation, and the other, the lower, for the heating season.

Reznor Mfg Co, Mercer, Pa.

HAND TORCH **P731**

Portable 2½-lb, instant-lighting, LP hand gas torch gives a flame of 3660 F. Torch operates most efficiently with propane.

Otto Bernz Co, 280 Hyell Ave, Rochester 6, N.Y.

STEAM GENERATOR **P727**

Model No. C 300 is an addition to this company's line of automatic, packaged steam generators. It comes fully equipped with a Cyclotherm burner, fully automatic safety and operating controls, steam trim, valves and other equipment to make up a complete unit.

No. C 300 is versatile since it can be fired with light or heavy oil, gas, or a combination of gas and oil. It is available in pressures from 15 to 200 psi.

Cyclotherm Corp, Oswego, N.Y.

HEAT METER **P738**

Standard 1⅜-in. diameter Heat-Flow meter uses the principle of the water-cooled calorimeter to take measurements of heat through to working fluids and substances.

Instrument serves as a probe with its black-body tip carrying two copper-constantan thermocouples inserted in the heating chamber. The meter itself consists of two concentric tubes arranged to take constant water flow. Water enters through an end fitting and passes through the center tube to the tip attachment point. Here the flow divides. Most of the water passes through a number of orifices to the annular space between the tubes. This water stream returns to the entering end of the meter by spiraling between the tubes and giving uniform heat transfer before passing to the drain.

Thermal Research & Engineering Corp, 1218 Chestnut St, Philadelphia, Pa.

TUBE BENDERS **P728**

Full 180-degree bends, and positioning at any point on the tubing, are advantages claimed for gear-type tube bender. High-tensile-strength materials are used throughout. All ferrous parts are cadmium plated. Bender is designed to work copper, brass, aluminum, steel tubing, including *Bundy* and thin-wall conduit. Individual benders are available for ½, ⅝, ¾, ⅞ and 1⅛ in. OD tube sizes, nominal tube sizes ⅜, ½, ⅝, ¾ and 1 in.

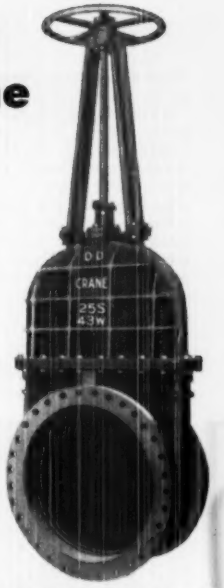
Imperial Brass Mfg Co, 1200 W. Harrison St, Chicago 7, Ill.

TESTING PUMP **P757**

A self-contained hydrostatic pump is ready for automatic operation when the air supply is connected. Definite relationship between the areas of the air piston and pump plunger automatically balances the air pressure against the required hydraulic pressure. For example, a 12-in air cylinder driving a ⅝-in. plunger and operating on

For further data on above items use reply cards on page 196a, identifying your request with letter P and number

How to simplify your piping jobs ...Standardize on the CRANE line



No. 793½, Outside Screw and Yoke. Working Pressures: 25 pounds steam or gas; up to 50 pounds cold water. Sizes: 10 to 48-inch.

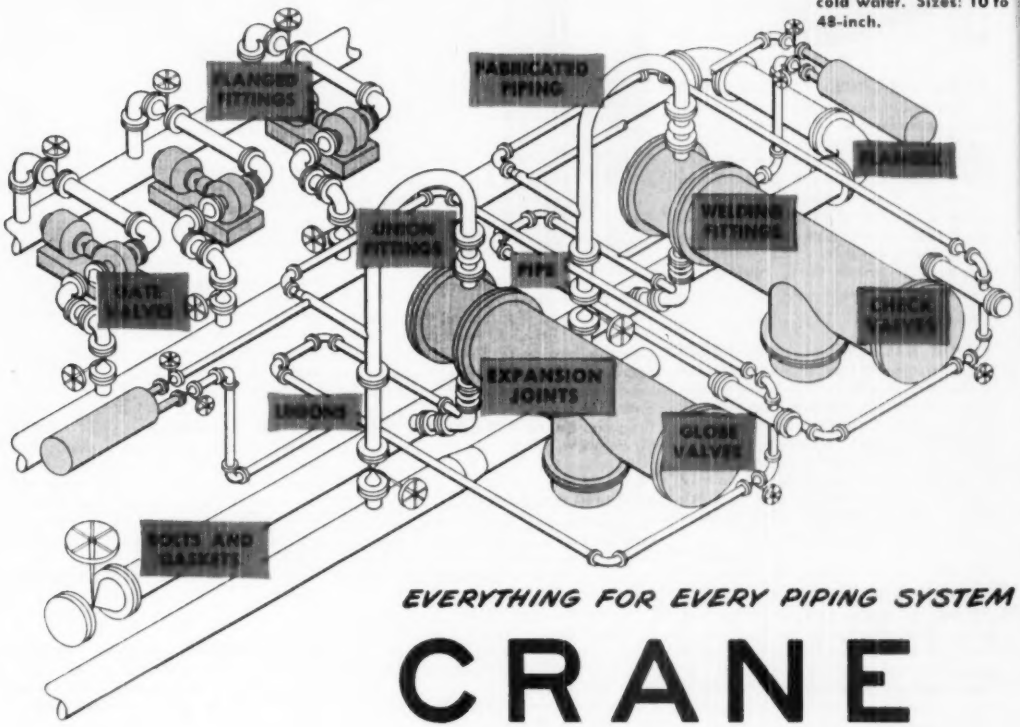
ECONOMICAL VALVES FOR LOW PRESSURES

Keep Crane 25-Pound Iron Body Double Disc Gates in mind for services that don't require the usual 125-Pound valves. Rated at 25 Pounds Steam or Gas, and up to 50 Pounds Water, depending on size, they give superior service in a wide variety of applications. Use them inside or out; their oval-shaped body and bonnet have ample reserve strength under line stresses. Short and compact, they take minimum space in pipe lines.

For durable, tight seating—yet easy opening—seat rings and disc faces are brass. Crane 2-piece ball-type gland maintains uniform pressure on packing; prevents binding on stem; lengthens packing life. When specified, these valves can be fitted with gears, by-pass, and clean-outs; also can be motor or cylinder operated; non-rising stem, flanged or hub ends, up to 36-in.; O.S. & Y. type with flanged ends only up to 48-in. See your No. 49 Crane Catalog.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

ONE ORDER TO CRANE COMPLETELY EQUIPS CIRCULATING, COOLING AND SERVICE WATER PIPING SYSTEMS



EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

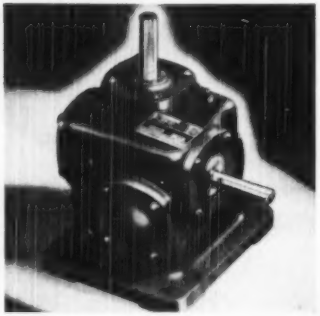
VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

80-psi air pressure develops 25,000-psi hydraulic pressure.

It tests boilers, pressure vessels, pipe and piping systems, shell and other hollow forgings, vacuum pumps, vacuum valves, chambers and dryers. It also calibrates and tests pressure gages and is used for many other hydrostatic test purposes.

Pump operates at full stroke length and maximum strokes per minute until the predetermined hydraulic pressure in the system is approached. Then the unit automatically slows down to the speed (strokes per minute) necessary to maintain the required hydraulic pressure.

Milton Roy Co, 1300 East Mermaid Lane, Philadelphia 18, Pa.



SPEED REDUCER P753

To serve fractional-hor-sepower and small-space requirements, this double-reduction speed reducer is designed for a multitude of duties in the transmission of small power loads. It is stocked in 24 different rightangle drive assemblies for reduction ratios of 25 to 1, to 1764 to 1. Range of speed eliminates the need for many owners to use larger, expensive speed reducers.

Winfield H Smith Corp, Springville, N. Y.

FLOOR MACHINE P722

All-purpose *Tornado* floor machine has a rotary safety-grip switch, fingertip solution control, fully adjustable handle, self-raising wheels, automatic brush-coupler, "Foam-Feed" brush, quick-change, snap-on brush rings. In addition to its everyday use for scrubbing, waxing, polishing, it may be used to sand, steel-wool, pumice all floors.

Breuer Electric Mfg Co, 5100 Ravenswood Ave, Chicago 40, Ill.

CURRENT-LIMITING FUSE P775

Type *EJ-6* fuse is designed for low-voltage circuits where available short-circuit current is above the normal operating range of conventional NEC standard fuses. Interrupting capacity of this fuse is 100,000 amp. Device is listed by the Underwriters and is available in two voltage ratings of

EQUIPMENT NEWS

NEC standard cartridge fuses, 250 and 600 v.

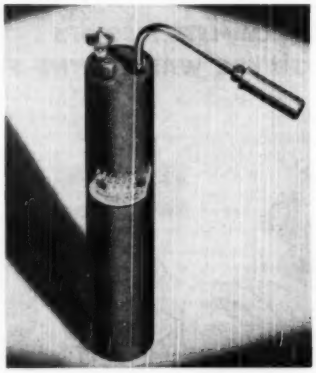
Both voltage ratings have four basic cartridge sizes: 30, 60, 100 and 200 amp. Typical applications are protection of branch feeders, lighting circuits, combination motor starters, control power circuits and other applications where conventional fuses do not have sufficient interrupting capacity.

General Electric Co, Schenectady 5, N. Y.

MAGNETIC FILTER P742

Permanent nonelectric magnetic filter has a 12-in. stainless steel chute into which is designed a series of magnetic fields. As liquids, slurries pass over the chute all fine iron is pulled out.

Eriez Mfg Co, Erie, Pa.



GAS SOLDERING P735

Self-contained in a 10½ in. high, 2½ in. in diameter cylinder, weighs only 4 lb, generates heat up to 2200 F with butane propane as fuel. Unit has a gas filter, burner shield, universal tip and fingertip control of pressure valve.

Precision Engrg & Mfg Co, 209 Center St, Saginaw, Mich.

THREADLESS FITTING P741

Threadless steel fittings, with soft-metal seals for use with ½- to 1½-in. pipe in tees, couplings, elbows, enable rigid connections of black or galvanized pipe without threading pipe ends.

To break into an existing line just cut it with a hack saw, part it a half inch, slip on a threadless fitting and tighten the seal nuts. Connection is said to withstand up to 2000 psi.

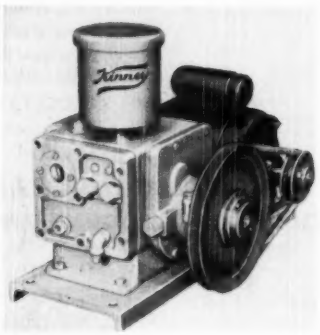
Union Products Co, 54 South Third St, Minneapolis, Minn.

MAGNETIC STARTER P766

Compactness and straight-line action of the moving mechanism, assuring positive contacting, are among the features of this unit. Arc is guided across and between quenching and baffle plates. Heatproof silicon chutes enclose each contact.

This size 4 *RA* unit has its terminals accessible from the top, while its contacts are equally accessible and simple to replace. Load and line wires are connected at opposite ends and may be evenly cut. Thermal-type over-load relays have one piece interchangeable heaters.

The Arrow-Hart & Hegeman Electric Co, 103 Hawthorn St, Hartford 6, Conn.



VACUUM PUMP P759

Small, compound vacuum pump uses oil-seal pumping system for high vacuum. Has a free air displacement of 4.9 cu ft per min and operates with a 1/3-hp motor. On a blank test, each unit is required to produce McLeod gage absolute pressure readings 0.001 mm Hg, or better. Double sealing-oil reservoirs give continuous oil purification, which promotes high vacuum regardless of surrounding atmosphere. It requires no warm-up period, going to work at the snap of the motor switch.

Kinney Manufacturing Co, 3532 Washington St, Boston, Mass.

WATER HARDNESS P718

This rugged, pocket-sized plastic box houses three vials of chemicals and one combination measuring and mixing vial for water-hardness testing. The *Versene* kit enables a 2-minute test of hardness, accurate within one grain of hardness per gallon.

Bersworth Chemical Co, Framingham, Mass.

MULTIPURPOSE GREASE P776

Alvania grease has a high melting point, good resistance to heat and water, hence can be used to replace sodium, calcium, aluminum and mixed-base greases. This

For further data on above items use reply cards on page 196a, identifying your request with letter P and number

It was 1912 — and the completion of the 57-story Woolworth Building attracted world-wide attention — when we introduced "Flexitallic", the *original* Spiral-Wound Gasket, and opened to Industry new fields of opportunity in the confining of fluids at high pressures and temperatures.

BALANCING GASKET DENSITY AGAINST UNIT LOAD . . .

Whether the gasket is .125" or .175" or .285" in thickness —

And whether the load is 5,000 lbs. or 40,000 lbs. p.s.i. of gasket area —

And regardless of temperature, pressure, thermal or physical shock, corrosion, vibration, unusual stress or other factors —

Each Flexitallic Gasket is so designed that, when bolted up cold with 30,000 lbs. stud stress, the *spring action* is at its highest efficiency.

Balanced density against unit load.

The basic Flexitallic principle — the spiral winding of V-crimped spring-like metal plies alternating with plies of filler — lends itself *naturally* to almost unlimited variation.

The physical and chemical properties of the several metals, the different types of filler, the relationship of filler to metal in winding — all these are *variables* in the hands of the Flexitallic engineer. Using the most precise instruments for the determination of yield values, resilience and gasket density, he builds each Flexitallic Gasket to an exact standard of performance.

If safe sealing is of serious concern to you, give us these facts on your gasketing requirements: (1) Fluid to be confined; (2) Type of Flange and dimensions; (3) Operating pressures and temperatures; (4) Bolting data.

In return we will send you a genuine Flexitallic Spiral-Wound Gasket. Test it severely — in your laboratory or on the job. The results will show you why the great oil refineries, chemical industries, power plants, ship yards, ship-operating companies and others in the high-pressure, high-temperature field are standardized on Flexitallic Gaskets.

FLEXITALLIC GASKET COMPANY
Eighth and Bailey Streets, Camden 2, N. J., U.S.A.

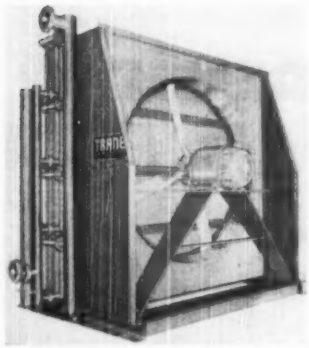
The name "Flexitallic" is the registered trade mark identifying the *original* (patented) Spiral-Wound Gasket. Now—for your protection and ours—this trade mark FLEXITALLIC is stamped into the outer ply of every *genuine* Flexitallic Gasket. Your guarantee of quality.

Flexitallic®
SPIRAL-WOUND GASKETS

multipurpose grease is pumpable at low temperatures.

Since it eliminates the need for several different types, inventories may be simplified and there is less chance of applying the wrong grease to expensive machinery. Lithium hydroxy stearate is the base for this grease.

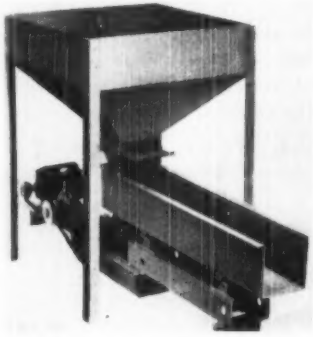
Shell Oil Co, 50 W 50th St, New York 20, N. Y.



WATER-JACKET COOLING P743

Fluid coolers, in 22 standardized sizes from 66,250 Btu per hr to 7,630,000, have been made available for air-cooling of engine jacket water and lubricating oil in diesel, gasoline and gas power plants. Each cooler has (1) cooling core made up of nonferrous tubes with extended surface fins (2) balanced propeller fan (3) heavy-duty casing to withstand wind and weather.

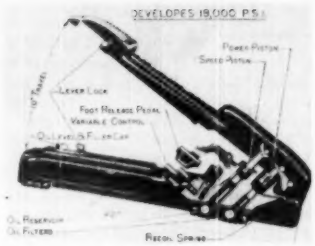
Trane Co, La Crosse, Wis.



VIBRATING FEEDER P747

Mechanical vibration-type positive-action *Free-Flow* feeder has a uniform conveyor speed, balanced, pendulum construction, and can handle hot or cold materials of any size or shape around corners, horizontally or up inclines.

Free-Flow Co, 1530 N Gordon St, Hollywood 28, Calif.

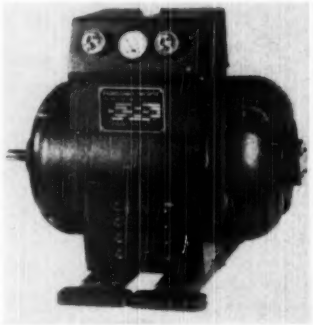


HYDRAULIC JACK P773

Go-Jak pump unit develops up to 20-ton pressure. Suited for assembly or disassembly of large parts that can be found in the average repair shop. Many new applications suggest themselves when a particular need arises.

Unit is foot operated, leaving both hands free to do the work that would require an assistant. Jack has two speeds; selector valve allows choosing the right speed and capacity to suit the job.

Wihtol Industrial, Lewis St, Eatontown, N. J.



BELTED GENERATOR P771

This generator may be belted to any available power unit or tractor to supply electricity when main line fails. Generators are furnished in two sizes, 3 and 5 kw.

Units are the 4-pole, self-excited type, designed for operation at 1800 rpm, 60 cycles, 120 volts. Two *Twistlock* receptacles are furnished with the 3-kw units and three with the 5-kw units. Convenient slide rail makes it possible to adjust belt tension after the power unit has been spotted in place.

Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago 5, Ill.

CLOSE-COUPLED PUMP P750

Balance rings relieve pressure on stuffing box of close-coupled pedestal-mounted centrifugal pump. Handles liquids ranging from water to those having viscosity of 2000 ssu. Has stainless sleeve on shaft in stuffing box. Pumps are dimensioned so they may be interchanged on different sizes

(*Continued on page* 156)

Check These, Too . . .

. . . Self-Lubricated Bearings made of carbon and designed to operate at temperatures up to 800 F without lubrication ..... p 182

. . . Cable Connector for tapping a branch electrical line into a "hot" 350,000 to 800,000 cm cable ..... p 182

. . . Mixing Tank for boiler feedwater-treatment solution mixing. This 53-gal agitator tank has a 22-in. ID ..... p 182

. . . Variable-Speed Pulley giving stepless control through a double-groove single-belt pulley. Will handle speed changes of 3 to 1 ..... p 184

. . . Turbine Pump designed for installation in limited space. Features capacity to 5000 gpm, maximum head to 1500 ft, mechanical-seal shaft ..... p 184

. . . Immersion Thermostat consisting of metal tube and rod, each with different coefficients of expansion. Unit is rated 1500 watts at 115-230 v ..... p 188

. . . Self-Contained Boiler designed for heavy oils and gas. Fitting in the 600 to 20,000-lb-per-hr range, unit has a single blower to furnish all combustion air ..... p 188

. . . Water-Treatment Compound prepared from vegetable juices ..... p 188

. . . Humidity Instrument consisting of two glass thermometers in a plastic pocket-sized case. Relative humidity found with built-in slide-rule set according to this sling-psychrometer's readings ..... p 188

. . . Iron and Steel Coating eliminates chromic-acid treatment; to be applied before painting ..... p 190

. . . Indicating Pyrometer for flush and surface mounting; has alnico V magnet ..... p 192

. . . Wetting Agent for treating ordinary water (or sea water) to increase its effectiveness in putting out fires. Solid 3-lb capsule produces over 1000 gal of treated water ..... p 192

. . . Dc Series Motor for mills. Greater power output without any increase in frame size ..... p 192

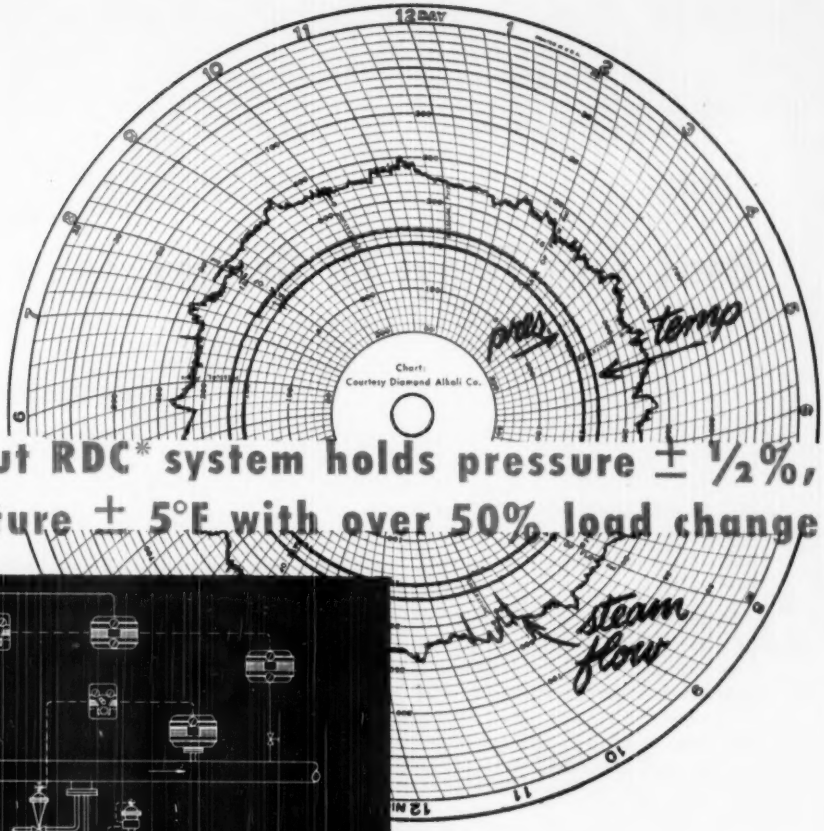
. . . All-Service Hose suitable for gasoline, water, oil, mild chemical, etc. Reduces varieties to be carried in stock ..... p 192

. . . Fluorescent Tester indicates whether trouble is in starter, tube or fixture circuit. Unit is pocket size ..... p 192

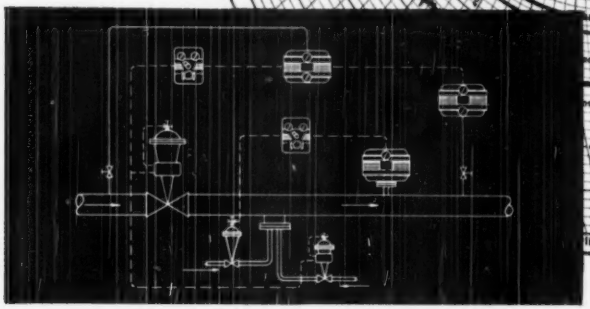
And Next Month . . .

Motor-Brake Combination having motor and brake in the same housing. Units are in the range up to 20 hp, and are available with explosion-proof, electrically operated brake. This brake-motor combination is suitable for cranes, hoists, conveyors, etc.

For further data on above items use reply cards on page 196a, identifying your request with letter P and number



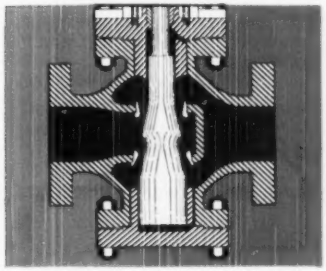
Swartwout RDC* system holds pressure ± ½%, temperature ± 5°F with over 50% load change



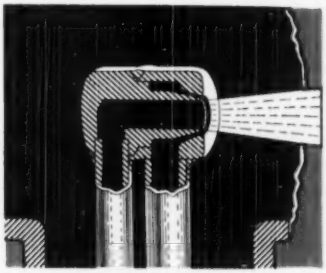
1 **RDC*—Reducing. Desuperheating and Control**—represents a single problem for which Swartwout assumes unit responsibility. Diamond Alkali Co. No. 4 RDC station at Painesville, Ohio, handles 200,000# steam per hour with reduction from 1450 to 152 psi; temperature from 900° to 438°F. Chart above shows the precision control of the Swartwout RDC system.

Swartwout

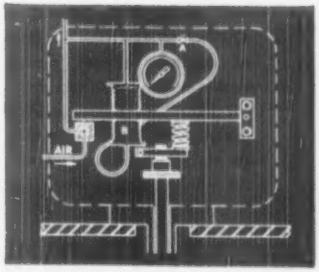
POWER PLANT EQUIPMENT



2 **REDUCING VALVE** for high pressure and temperature applications utilizes rugged construction and larger diameter stem to assure smooth action and long life. Disc and seat contours form nozzle-shaped passages which minimize turbulence and eliminate undue noise and life-shortening vibration.



3 **STEAM ATOMIZING** desuperheater has nozzle in center of steam line for effective narrow-angle dispersion of completely atomized water. Nozzle is accurately machined for each installation to give high velocity with existing atomizing steam pressure. Swartwout also makes carburetor and mechanical atomizing types.



4 **TEMPERATURE CONTROL** combines wide throttling range with automatic load compensation for close temperature control. Needle valve A adjusts rate of flow to and from reset bellows B, establishing load compensating characteristic. Operation is stable regardless of load change and time lag. A-2972

SEND FOR BULLETINS S-21-E, S-22-C, S-199. THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

Don't Take Things for Granted

Mike had been working around power plants most of his life, but mostly with hrt boilers. Even so, his experience was enough to land him a job as maintenance man with a large industrial using big water-tube boilers.

He hadn't been on the job long when a big unit came off the line for annual cleaning. After the boiler had been purged and allowed to cool, the maintenance supervisor grabbed Mike and sent him into one of the rear passes with chipping tool and water hose. Mike's only orders were to "clean out that soot." And that's just what he started to do—only in his own way.

The soot was pretty cool on top, but Mike figured, rightly so, that it wouldn't be as cool underneath. So he stuck the end of the hose nozzzle right down into a deep pile of soot and ash to cool the lower stuff. Then he wandered a few feet away to work on a cooler spot.

But Mike didn't realize that the hose nozzle was buried in a pile of practically red-hot ash. The water squirting in flashed to steam. The top of the layer of ash, however, had cooled into a crust, keeping the steam from escaping as it was formed. You can guess what happened. Steam pressure built up under that crust. Suddenly it let go and Mike was showered with hot soot and ash. All of his clothes were burned and most of his skin. Luckily he lived, but he'll never work again.

Mike's accident brought the supervisor up on the superintendent's carpet to explain what happened. The supervisor claimed the job was so simple that any damn fool should know how to do it right.

"What should he have done?" asked the superintendent.

"Why sprinkle the cold water on top of the soot and let it soak through to cool the hot stuff underneath more slowly," answered the supervisor.

Then the superintendent let loose.

"You're the damn fool. It took you exactly five seconds to tell me how the job should have been done. If you'd given Mike that same five seconds' worth of advice, this whole mess would never have happened."

This tragedy has a moral for all of us. How many mistakes could be avoided if we'd take time to tell people not only what we want done, but also a little of the *how* and *why!*

George Edwards

Engineer

P.S. In the case I've cited, I suspect also that the supervisor ordered Mike into the boiler too soon. He should have personally checked to see that it was cool enough to work inside. That's another thing he took for granted.

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

Dowell Service increased water output 100%!

Water wells need cleaning, too. This company has a 33-year-old well in which volume had been cut by scale incrustation and corrosion deposits on the well screen, pump, tubing and on the face of the producing formation itself. Dowell Service quickly removed these deposits in a few hours without removing the pump and column. Water production was increased from 64 to 135 g.p.m. with a drawdown decrease of 27 feet.

Dowell Service may be the answer to your cleaning problem. Profit-stealing deposits in steam generators, condensers, gas washers, water lines . . . in hundreds of different types of process equipment . . . can be removed *chemically*. Dowell engineers fill the equipment with liquid solvents that flow wherever steam and water go and are designed to remove the deposits in a few hours without dismantling.

If you have a cleaning problem . . . a place where deposits are causing a maintenance headache . . . call Dowell. Skilled cleaning engineers are available for consultation at no obligation.

Other recent Dowell jobs:

Bubble Cap Columns cleaned for large refinery. Cleaning so successful that maintenance engineers plan to make Dowell Service an annual job.

Two Blast Furnace Gas Scrubbers cleaned in 8 hours. 48 hours apiece required when cleaned mechanically.

A 3,000 Horse-Power Stirling-type boiler and economizer were both cleaned in a single operation requiring only 24 hours.

CALL

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

New York 20	Buffalo 2	Kansas City 8	Mt. Pleasant, Mich.
Boston 16	Cleveland 13	Wichita 2	Hamilton, Ohio
Philadelphia 2	Pittsburgh 19	Oklahoma City 2	Charleston 27, W. Va.
Baltimore 18	Detroit 2	Houston 2	Salem, Illinois
Wilmington 99	Chicago 2	New Orleans 12	Borger, Texas
Richmond 19	St. Louis 8	Ft. Worth 2	Midland, Texas
Jacksonville	Indianapolis	Shreveport 69	Wichita Falls, Texas
Atlanta	Louisville	Anniston, Alabama	Lafayette, La.

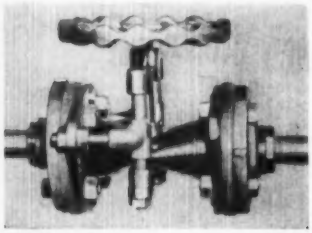
Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

A SERVICE ORGANIZATION

of motor frame, without altering shaft or flange mountings. Constructions are cast iron, bronze, bronze fitted, and special alloys.

Gorman-Rupp Co, Mansfield, Ohio.



PINCH VALVE **P739**

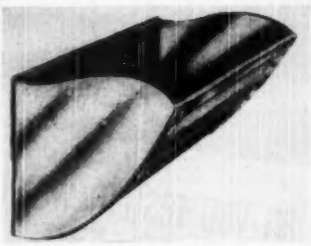
New rubber, packing-free, abrasive- and corrosion-resistant pinch valves shown in closed position, comes in sizes from 1½ to 2 in. It serves mining, paper, chemical, oil, food industries.

United States Rubber Co, Rockefeller Center, New York, N. Y.

PIPE WRENCH **P730**

Rugged, light, 14-in. aluminum pipe wrench has interchangeable, replaceable alloy-steel-jaw inserts.

J H Williams & Co, 400 Vulcan St, Buffalo 7, N.Y.



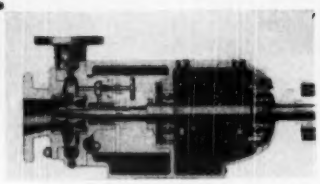
ELEVATOR BUCKETS **P761**

High-speed elevator buckets handle any powdered or granular free-flowing material that is not highly abrasive. They perform equally well at high, medium or low speeds, and are suitable for replacement or new installations in chain or belt elevators.

Buckets are heavy-gage cold-rolled steel. Long life is assured by a rolled front lip of double thickness so constructed as to be rigid. Bucket ends are formed to support the body. Ends and body are spot welded to remove all shear stress from the welds.

Body shape provides for maximum load and clean, quick discharge at varying belt speeds. Tapered ends decrease friction on pickup and discharge, and allow nesting of buckets for shipping and storage.

Fort Worth Steel Machinery Co, 3600 McCart St, Fort Worth, Texas.

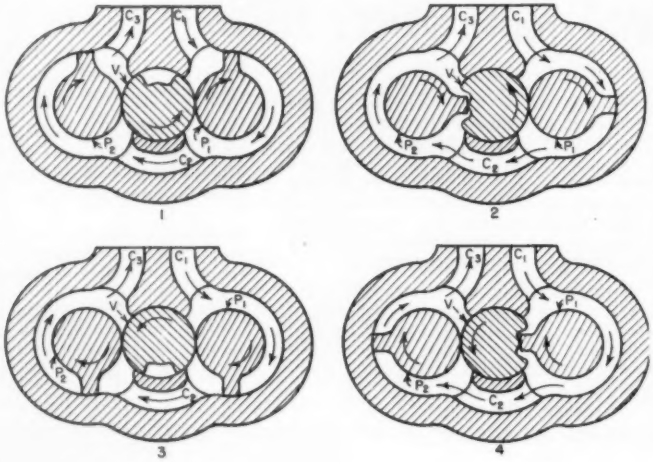


CENTRIFUGAL PUMPS **P755**

Cradle-mounted centrifugal pump has deep watercooled stuffing box, smothering gland, ring-oil-lubricated ball bearings, a heavy cradle shaft and bearing, channel steel baseplate and an all-metal coupling. Impeller is mechanically and hydraulically balanced. An extra-deep stuffing box accommodates five or more packing rings and is easily accessible.

Pumps are built in five sizes, single and two stages. Sizes range from ¾- to 5-in. discharge with capacities up to 1600 gpm and heads up to 250 ft. Normal horsepower range is from ¼ to 75. They may be driven by direct electric motor, electric motor and V-belt, turbine through reduction gears, direct turbine, V-belt gasoline engine, or direct gasoline engine. These units are suitable for paper mills, breweries and distilleries, chemical plants, refineries, building and contracting, and general manufacturing process.

Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.



ROTARY-PISTON PUMPS—CAPACITY TO 45 OGM **P754**

High-pressure positive-displacement rotary-pistion action continuously sweeps fluid channel to give uninterrupted flow with negligible velocity changes. In its simplest form pump consists of two rotating pistons with an abutment valve between. In the figures, P_1 and P_2 are the rotating pistons; V, the abutment valve; C_1, inlet channel; C_2 transfer channel; C_3, outlet or discharge. All three rotating elements are geared together and are driven by a power unit connected to the abutment-valve shaft.

If the abutment valve is rotated counterclockwise, pistons turn clockwise as shown. Pistons P_1 and P_2 alternately operate on discharge pressure. In Fig. 1, piston P_2 is on discharge. On its left-hand side, piston is on suction, and on the right it is discharging through channel C_2 to piston P_2.

When the pistons have moved to the position in Fig. 2, P_2 is in a neutral position where it is neither on suction nor discharge. P_1, however, is the high-pressure piston and is discharging through C_2 and C_3. There is a rolling seal between V and P_1. In Fig. 3, P_2 is again the high-pressure piston, discharging through C_3 where P_1 is on suction. A rolling seal is formed between P_2 and V, also P_1 and V.

Seal between P_2 and V is the only one under pressure unless it leaks. Then a pressure difference also exists across the seal between P_1 and V, and piston P_1 and the cylinder wall. When the pistons turn to the position in Fig. 4, P_2 is on discharge and suction, whereas P_1 is in neutral. By these actions a continuous discharge is obtained without pulsations.

This unit is used as either motor or pump. One unit can serve as a pump while another is a motor in a hydraulic power-transmission system. Pump pressures range up to 3000 psi and capacities to 45 gpm. Hydraulic motor horsepower goes up to 79 and speeds to 6000 rpm.

Berry Motors, Inc, Corinth, Miss.

(*Continued on page* 158)

For further data on above items use reply cards on page 196a, identifying your request with letter P and number

The All-Purpose Steel Valve!

NEW FIG. 444 SERIES!

1. Yoke Bushing: Hard bronze, lock welded to yoke.

2. Yoke: Forged steel, integral gland rest, screwed and lock welded to bonnet in union type; integral with bonnet in bolted design.

3. Bonnet: Built-in back-seat, big packing chamber; either rolled steel union ring or forged steel stud bolted type.

4. Packing: EValpak, die formed, water-proofed, treated to prevent stem pitting.

5. Gasket: Ironkote 90 Brinnell max. for leak-proof joint.

6. Disk: EValloy 13% chromium or Stellite, slotted or disk nut type, self-centering.

7. Seat: EValloy 13% chromium or Stellite on stainless steel; borized in mated pair with disk.

8. Handwheel: Malleable iron, knobbed for easy gripping.

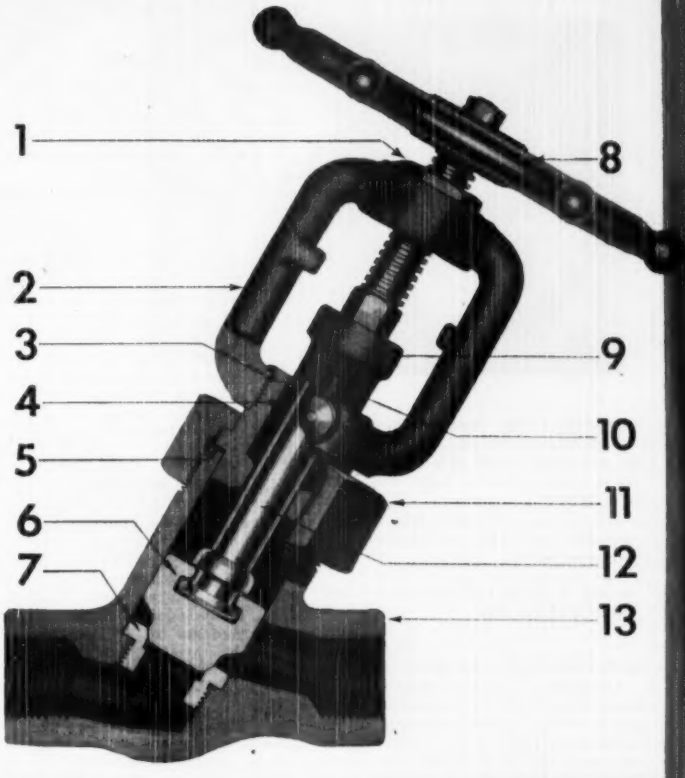
9. Gland: Forged steel, through bolted, accurately fitted to stuffing box.

10. Swing Gland Bolts: Forged steel, EValized for longer, corrosion-free life; swivel out of way but can't come off.

11. Union Ring: Rolled or forged steel, hexagonal.

12. Stem: Hardened, centerless ground EValloy, with backseating shoulder (on disk nut on larger sizes).

13. Body: Heat treated forged steel, inclined stem globe type for lowest pressure loss, screwed or socket welding ends.



EDWARD VALVES, INC.,
1220 West 144th St., East Chicago, Indiana

Please send a copy of Bulletin 501 describing your new Fig. 444 all-purpose forged steel valves.

Name _____

Company _____

Address _____

City _____ Zone ____ State _____

NOW READY! New Bulletin 501 gives you dimensions, ratings, full data on the new Edward Fig. 444 series. Send coupon now for your copy.

Another Product

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

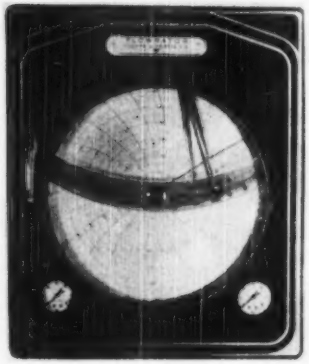
Edward Fig. 444 series are built in sizes ¼ to 2 in. inclusive, globe or angle, screwed or socket welding ends, 6000 or 1500 lb wp classes, in carbon or chromium molybdenum steel.

EQUIPMENT NEWS *Continued*

FLEXIBLE TUBING P736

Lightweight, heat-resistant, retractable (87% cubic reduction) flexible tubing, *Spiratube*, is available in standard plies and materials, as well as in special materials, and in sizes to satisfy duct requirements from 3- to 30-in. ID.

Flexible Tubing Corp, Branford, Conn.



TEMPERATURE, PRESSURE P725

Temperature elements, *Ratotherm*, have thermal systems filled with liquid, vapor-liquid or gas, and cover ranges from −125 to +1000 F.

Pressure gages, *Ratogage*, have bellows, multi-diaphragm, slack-diaphragm or helical pressure-measuring elements covering ranges between 30 in. Hg and 10,000 psi.

Fischer & Porter Co, 86 Country Line Road, Hatboro, Pa.

LONG-SCALE INSTRUMENT P719

Large 28¼-in. scale instruments have a spot-of-light pointer so accurate readings can be made at great distances. Instruments can be installed singly or in multiple for speed and power indications, dynamometer readings, generator outputs. They can be furnished with any type movement or sensitivity such as is obtainable with ammeters, voltmeters, wattmeters, pyrometers, tachometers.

The light-beam pointer is produced by light passing from a self-contained light source through a precision optical system reflected on a first-surface mirror directly upon the instrument scale.

Cole Instrument Co, 1320 South Grand Ave, Los Angeles, Calif.

GAS BOOSTER P720

Lightweight, single-stage, direct-connected cast-aluminum gas boosters come in 15 sizes, from 3800 to 86,000 cu ft per hr capacity, and raise pressure over a range from 3-in. water column to as much as 46-in.

Bryant Industrial Div, Affiliated Gas Equip Inc, 17825 St. Clair Ave, Cleveland, Ohio.

MEGOHMMETER P746

Small 7½ x 4 x 4-in., 4-lb 14-oz *Megohmer*, the *Major*, gives constant-pressure test voltage for high- and low-resistance measurements. Unit has an auxiliary ohm scale, 0-30 ohms, down to ½ of 1 ohm, or 0-10,000 ohms reading down to 1 ohm per division.

Herman H Sticht Co, Inc, 27 Park Place, New York, N. Y.

ROOM CONDITIONER P721

Improved room air conditioner for office use measures for a ½-hp size only 13 in. high by 27 in. wide with a 6000-Btu-per-hr rating. A ¾-hp 8500-Btu-per-hr model is also available. No plumbing connections are needed; 110-volt ac. only.

Airtemp Div, Chrysler Corp, Dayton 1, Ohio.

HOIST CRANE P729

Fluid-drive, magnetic-control, rigid-bridge, streamlined design, and reduced headroom requirements feature the E-type intermittent-duty hoist crane. They are built in capacities up to 12 tons, spans from 20 to 60 ft. Usually they are operated from the floor by pushbutton control but cab-control can be supplied.

Whiting Corp, Harvey, Ill.

ENGINE WATERCOOLER P734

Heavy-duty, corrosion-resistant, *Monoweld*, fabricated-steel engine-jacket water-cooling radiator maintains a maximum jacket-water temperature of 180 F with 120 F ambient air temperature. It cools a 173-hp diesel engine running at 720 rpm driving a 100-kw generator.

Young Radiator Co, Racine, Wis.

SCREW-TYPE PLUG P769

Neon-flow lamp is built in this rugged female plug serving both as a pilot to indicate voltage, and as an easy-to-find light for speeding up operation.

Model 1200 plug body is a nylon-housed screw-type electrical receptacle. The neon-glow lamp has a life greater than 25,000 hr and consumes less than 0.1 watt.

Industrial Devices, Inc, Edgewater, N.J.

LIQUID LEVEL P749

For measuring liquid-level changes greater than 5 in., a displacer-buoy of selected dimensions and properties has been developed to match liquid-level changes to the standard travel of the company's liquid-level meters.

An electron impedance bridge, or a patented magnetic transmitter, transfers level readings to the exhibiting instrument. If operation is at atmospheric pressure only a direct mechanical connection need be made to the meter.

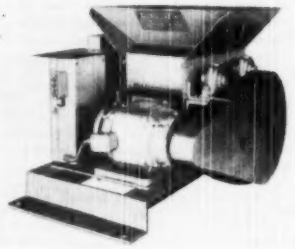
Fischer & Porter Co, 751 Country Pine Road, Hatboro, Pa.

WATER-FOG NOZZLES P770

Five kinds of discharge can be had from one nozzle by inserting this *FF* Foam Extension Unit in the *SG*-48 water fog nozzle. Result is an all-purpose nozzle that handles any type fire in ordinary combustibles.

Rockwood foam liquid can thus be automatically mixed with water and supplied to the *FF* extension.

Rockwood Sprinkler Co, 38 Harlow St, Worcester 5, Mass.



COAL CRUSHER P745

Light-weight heavy-duty coal crusher, the *Two Stage*, is 42 in. high, 47 in. wide, 6 ft 3 in. long. It incorporates two crushing stages in one machine to convert run-of-mine coal to stoker size in operation.

T J Gundlach Machine Co, Belleville, Ill.

DEMINERALIZER P732

Canister demineralizer, the *C51B unit*, fits in any faucet and is said to convert tap water to a purity suitable for battery water. Built-in electronic indicator shows purity of delivered water. When purity falls off the demineralizer canister can be readily replaced with a fresh one.

A E Tomkin & Co, 1828 Columbia Rd, N.W., Washington 9, D.C.

LEAK DETECTOR P767

Suitable for detecting leaks of methyl chloride, dichlorodifluoromethane, methylene chloride, carbon tetrachloride, trichlorethylene, etc.

Unit uses a photoelectric photometer to indicate changes in intensity of the blue spectrum of a copper arc discharge in the presence of organic halide vapors. Instrument is accurate to within 10%.

Davis Emergency Equipment Co, Inc, 45 Halleck St, Newark, N.J.

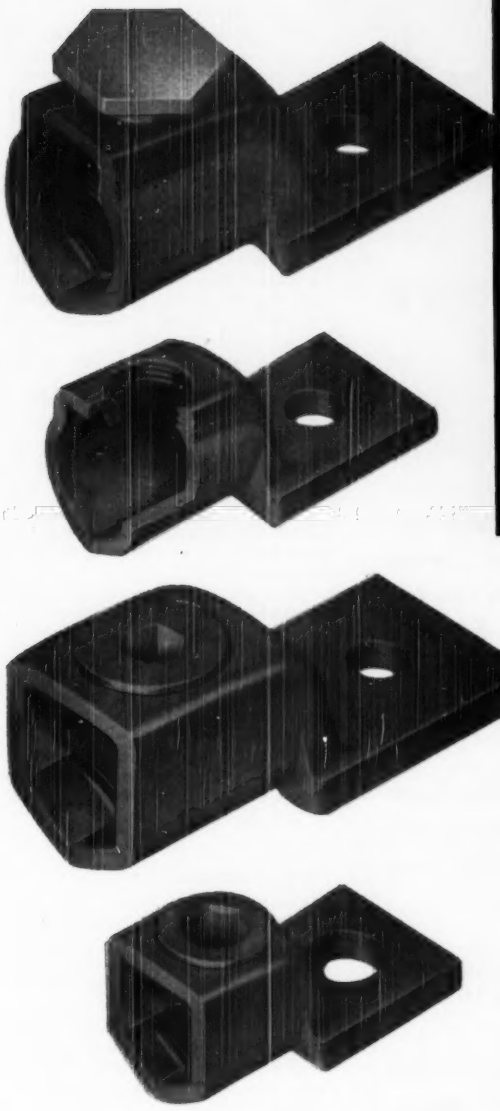
LUG CRIMPING TOOL P764

Air-operated for crimping solderless terminals to wires from No. 6 to 1/0. Detachable heads handle either conventional side-position crimping or stub (end) work. Unit operates from standard air outlets of 85 psi.

Air-Marine Products Inc, 1416 N 4th St, Harrisburg, Pa.

(*Continued on page* 182)

For further data on above items use reply cards on page 196a, identifying your request with letter P and number



Overwork makes these lugs Stronger...

. . . they're fabricated from Revere Seamless Copper Tube

WHEN Ilsco Copper Tube & Products, Inc., Cincinnati, Ohio, first designed their new type electrical wire connectors, they insisted that the product requirements, which were rigid to begin with, not only be met, but exceeded.

These requirements included mechanical strength, adequate electrical conductivity and uniformity, plus ease of application and long life with no season cracking. So it wasn't easy to find a material that would fill the bill. Because of favorable past experience, Ilsco tried a certain type of Revere Seamless Copper Tube. They gave it the complete cold-working treatment: forming, sawing, drawing, shaping, separating, expanding, tapping, reducing, and piercing. They not only came up with a connector without distortion, but one that, because of its one-piece seamless construction, had the additional strength necessary to withstand Underwriter's Laboratories tests for secureness and the hard usage and abuse the connectors would receive in the field.

The use of Revere Seamless Copper Tube resulted in finished connectors with a smooth, even, bright finish . . . no pitting . . . produced connectors that average over 50% cooler in operation than the maximum allowed by Underwriter's Laboratories.

Perhaps Revere can be of help in improving or developing your product . . . cutting your production costs. Why not tell Revere about your metal problems? Call the Revere Sales Office nearest you today.

SHOWN ABOVE are a few of the various styles and sizes of ILSCO Connectors. All are drawn and formed from Revere Seamless Copper Tube. They have 100% electrical conductivity, permitting a more compact unit, with a wide wire range for each size. However, only 6 sizes provide for the entire wire range from # 6 to 600 MCM.

NOTE CUTAWAY VIEW of the connector second from top. See how the one-piece seamless construction permits deep extrusion with a greater number of threads. In spite of their husky construction, these lugs are from 3 to 6 times lighter in weight than cast types of equal carrying capacity.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

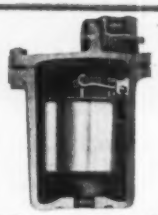
Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.
Sales Offices in Principal Cities, Distributors Everywhere

Anyway you figure it....

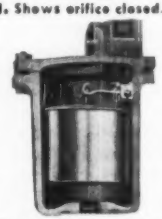
You get TWICE the VALUE with...

Clark DUO-STEP Leverage STEAM TRAPS

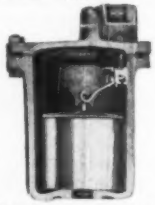
HERE'S HOW DUO-STEP WORKS:



1. Shows orifice closed.



2. First fulcrum point "cracks" orifice.



3. Second fulcrum point moves valve from orifice.

The amazing new Clark Duo-Step design actually *doubles* the drainage capacity of Clark Steam Traps. This means *double value* anyway you figure it. Now you can use smaller, less expensive traps for larger drainage jobs or get *twice* the drainage from traps you have been using.

Sound good? It is! Better look into Clark Duo-Step *today* and start saving real money on your steam trap requirements.

THE CLARK MANUFACTURING COMPANY
1831 East 38th St., Cleveland 14, Ohio

GET THE WHOLE AMAZING STORY, SEND FOR THIS BOOKLET -Today!

Clark DUO-STEP Leverage

Clark FLUID CONTROLS

Plant Problems

(*Continued from page 136*)

cooler. Adjust valves to maintain low superheat at evaporator outlets. Assuming his compressor has ample capacity at full load, this is the simplest and least costly remedy. If he chooses this solution, he must remember that locating bulb at proper point is essential. with top-inlet, bottom-outlet for lowest superheat.

Even more stable superheat at evaporator outlet, with vapor near saturation point, may be had with float-type expansion devices, with or without backpressure regulators. While installation of this type expansion and changing to flooded operation may be expensive, it is the surest way to keep frost on the evaporators.

GEORGE HOLMAN *Decatur, Ill.*

Recirculate Cold Air

I HAD THE SAME TROUBLE as *WH* in a 20x75x16-ft cold-storage room with cold brine coils suspended from ceiling and both sides of room. Operating temperature was 34 F.

Cold air stays down on the floor. Warm air enters the room when doors are opened. Moisture in this warm air condenses on coils, causing drips.

I installed three induction-type suction fans, 36 in. dia, by suspending them from the coils about 8-ft above floor. They recirculate the cold air from the floor, giving a uniform temperature. Dripping and condensation have stopped.

W F MAIER *S. Ozone Park, N.Y.*

Try 2-Bladed Fans

TO OVERCOME *WH*'s drips I suggest:

1. Replacement of manually operated valves by temperature-sensitive regulators with thermal bulbs at level of introduced produce, and as near door as possible.

2. Below the coils, suspend several 2-bladed fans of the low-velocity type. I cannot suggest the number as I do not know the form, tonnage and number of loads introduced at one time.

Effectiveness can be tested by installing one fan and opening the expansion valve manually after a load is put below the fan.

Temperature-sensitive bulb of the regulator should be located only in the path of the return air rising up to the cooling coils and not in the down draft or fan discharge. These regulators should be the type called "Reverse-Acting Temperature Controller" to maintain 34 F by admission of cooling solution through the direct-acting

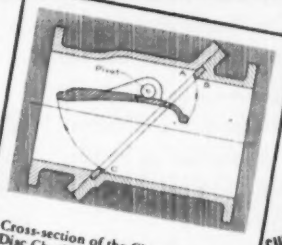
HOW MUCH DOES SLAMMING COST YOU EACH YEAR?

CHAPMAN (TILTING DISC) CHECK VALVES

Take just a moment to figure how much the slamming of ordinary check valves is costing you in extra maintenance. You'll find it's *plenty!*

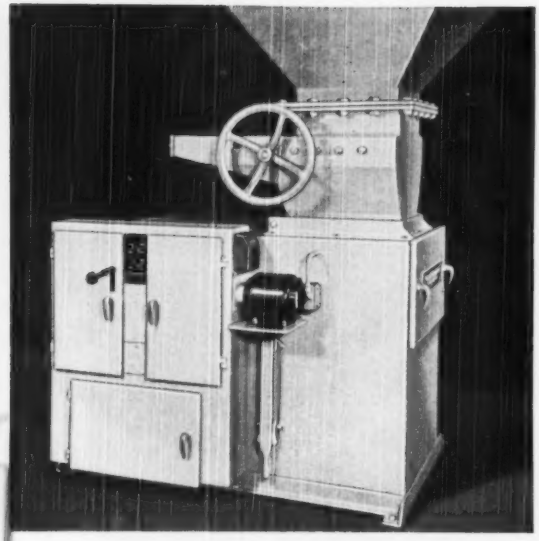
Then switch to Chapman Tilting Disc Check Valves. You'll eliminate the slamming that causes those destructive pipe line stresses. Most of the wear on seats and hinges, too. And head losses will be almost 80% lower than for conventional type check valves.

Those features mean important savings. Yet there are many more. Write today for additional information.



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The Chapman Valve Mfg. Co. INDIAN ORCHARD, MASSACHUSETTS

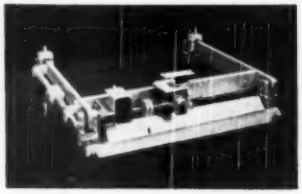


ACCURACY OF COAL WEIGHTS IS ASSURED

with S-E-CO. COAL SCALES

Accuracy is the paramount requirement of any scale. The steel weigh lever system, steel loops, hardened steel pivots and bearings used in S-E-Co. Scales, give a minimum weight to these parts. This light weight means low inertia, faster action, and therefore greater accuracy. Only S-E-Co. Scales are equipped with light weight steel levers and loops.

If you wish to have accurate weights of coal fed to each pulverizer or stoker, use S-E-Co. Coal Scales in your plant.



Write for Bulletin

STOCK EQUIPMENT COMPANY

715P Hanna Building ★ Cleveland 15, Ohio

diaphragm in the coils in place of the manually operated valves. Air-operated regulators, though more expensive, are preferred as the self-acting type requires a larger temperature change to operate—especially as valve size increases over 1 in.

Further refinement is achieved with zonal control of fans by individual thermostats.

A M Elliott *Le Roy, N.Y.*

Four Operating Hints To Minimize Dripping

Pans designed to permit circulation of air and catch drip during normal operation or defrosting are generally used with overhead refrigerating coils.

If pans cannot be used, dripping can be minimized as follows: (1) Install thermostatic expansion valve so evaporation of refrigerant continues for full length of coils. Far end of coils will not warm up and drip. (2) Remove frost from coils regularly by scraping. (3) Run compressor all the time. If room gets too cold and freezes produce, either reduce compressor speed slightly or throttle suction valve slightly. This raises room temperature a little by increasing pressure and temperature of evaporating refrigerant. (4) Don't leave door open or bring in large quantities of warm produce at one time.

Accumulation of frost on the coils can be slowed by adding a vestibule, preferably refrigerated, to limit the entrance of outside air; and by prechilling produce.

Arhtur Holt *Atlantic City, N. J.*

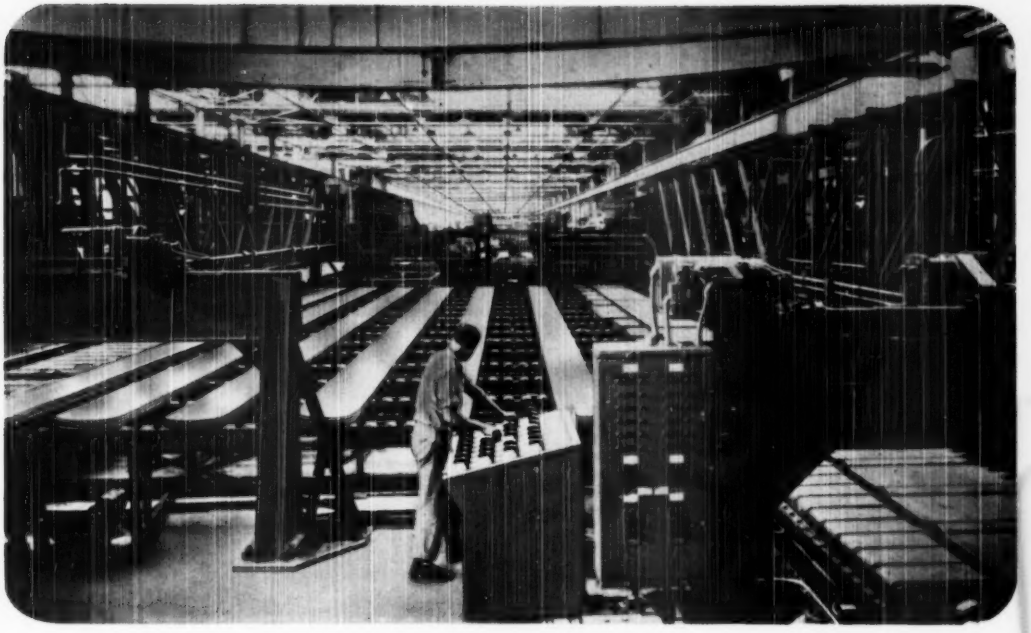
Thermal-Expansion Valve Recommended

Defrosting of *WH's* evaporator coils occurs when expansion-valve setting does not permit enough ammonia to enter coils to meet increased load. Result is excessive superheating of vapor and defrosting of coils.

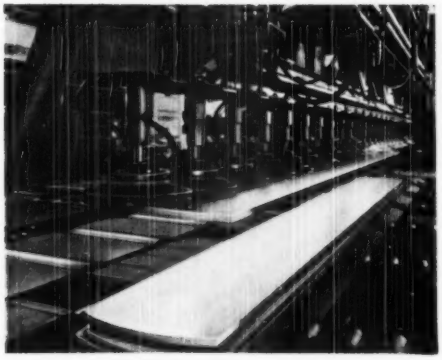
A thermal-expansion valve in place of the manual-expansion valve provides the means for meeting increased load requirements. Temperature bulb, which actuates the thermal-expansion valve, should be placed in the suction line to compressor at the evaporator-coil outlet.

But remember, compressor and condenser have to be adequate to handle the increased vapor load; otherwise, installation of a thermal-expansion valve has no great value. Most refrigeration manufacturers can make recommendations on type and capacity of expansion valve for *WH's* requirements.

R Pettinicchi *Fort Worth, Texas*



TO BUILD OR NOT TO BUILD



The smaller illustration is of the vacuum cup handling equipment operating in conjunction with the 2-Hi Cold Rolling Mill. Because of the massive size and weight of individual brass bars, all handling is mechanical.

This Mill, designed and constructed by Stone & Webster Engineering Corporation, is capable of producing the heaviest non-welded coils of strip brass, and includes the largest cold breaking-down mill in America.

For Scovill Manufacturing Company, Stone & Webster Engineering Corporation carried on continuing studies of the client's production operations over a period of four years. Analysis was made of production pattern for anticipated requirements, with costs of production in proposed mills compared with costs in the existing plant.

Companies today, faced with improving production facilities or lowering cost of plant operation, find comprehensive engineering reports by Stone & Webster Engineering Corporation valuable in developing sound, long range production plans.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

WHEN SEEKING THE SOLUTION
TO A WATER CONDITIONING PROBLEM

Remember
There's no substitute for Experience!

COCHRANE

SLUDGE CONTACT REACTORS

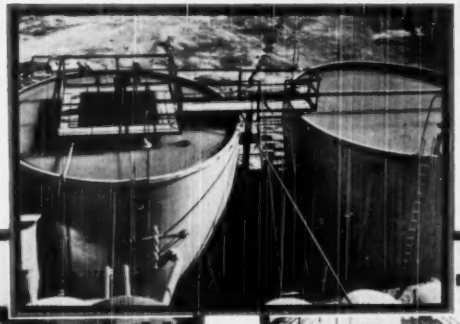
For the Clarification of Water and the Recovery of Waste in Process

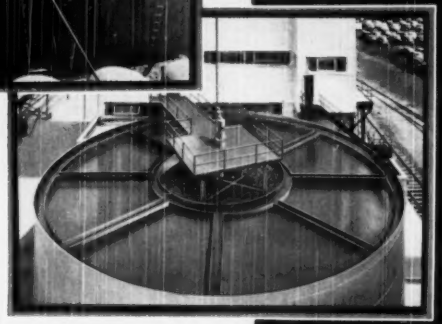
Clarifies water by use of sludge contact principle.

Raw water and chemicals enter near the bottom of the tank. Motor driven agitator mixes them thoroughly forming floc or precipitate. The agitator also keeps the floc or sludge suspended, so that the water is both treated and filtered by the sludge bed or blanket as it rises in the tank.

COCHRANE's specialization in the conditioning of industrial water supplies over the past fifty years and the combined years of experience of Cochrane engineers in that field, is your assurance of satisfactory service from any Cochrane installation. In the new method of sludge contact or removal by flocculation of impurities, turbidity, color or hardness, the Cochrane Sludge Contact Reactor accomplishes all these functions with complete efficiency and surprising economy. A new bulletin, Publication 5001, is available and will be sent on request.

The inclined blades of the agitator cause water and sludge to be deflected to the center where the mixture rises through the central port and is then recirculated back to the bottom, saving chemicals and producing a heavier floc. Central steel baffles divide the Reactor into a mixing zone at the bottom and a clarifying zone at the top.





COCHRANE CORPORATION

87 YEARS OF SERVICE

17th St. Below Allegheny Ave.
Philadelphia 32, Pa.

In Canada: Canadian General Electric Company, Ltd., Toronto
In Mexico: Babcock & Wilcox de Mexico, S.A., Mexico City

How to *INCREASE BOILER RATINGS*

with your present furnace and stack

Coppus-Dennis FANMIX Burners Give You More Heat with No Other Major Change in Equipment

Coppus-Dennis FANMIX Burners give you *perfect* mechanical mixing of fuel and air *at the burner outlet . . . instantaneous* ignition close to the burner . . . and *complete* combustion *without visible flame* when burning natural gas. No other burner combines these three advantages.

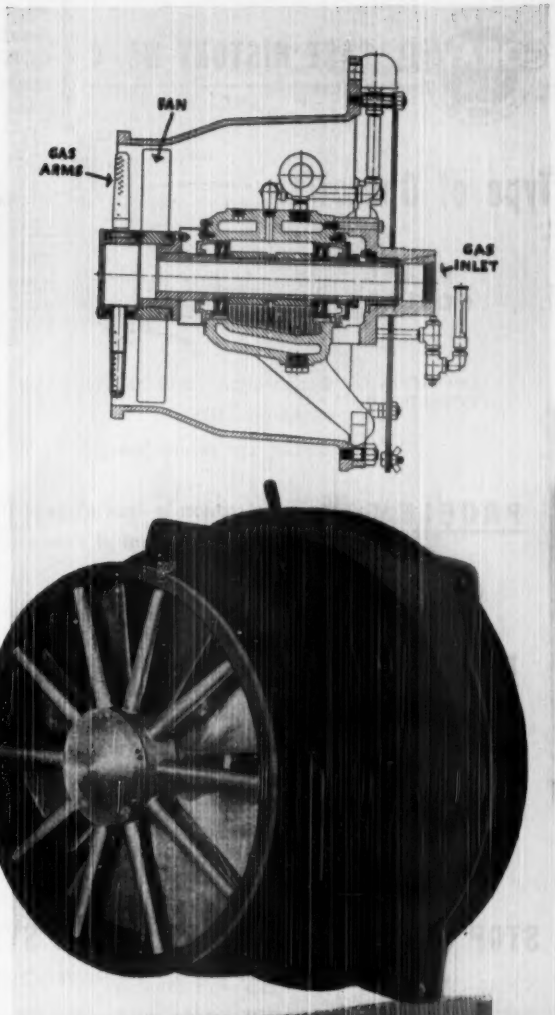
Because FANMIX delivers the *right* mixture of fuel and air *without blow-torch action*, all of your furnace space is used for combustion . . . *none for mixing*. That's why your present furnace can release more heat . . . why new installations can get more heat out of smaller furnace space.

Because FANMIX can be guaranteed to secure complete combustion of natural gas *with less than 5% excess air*, you get uniform "radiant heat" *without drifting hot spots*. That's why a FANMIX-fired furnace seldom varies in temperature more than 5% over its entire area.

WRITE FOR ALL THE FACTS

When you see in Bulletin 410–5 how fuel escaping from orifices in rotating driver arms rotates the fan to draw the correct proportion of air into the path of the fuel at right angles . . . how FANMIX creates its own forced draft, reduces stack requirements, prevents cracking of "wet" gas . . . how two FANMIX types handle either gas or oil or any combination of both — you'll understand why FANMIX Burners have such wide acceptance in oil refineries and power plants.

Send for the Coppus-Dennis FANMIX Bulletin 410–5. Coppus Engineering Corporation, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, and REFINERY CATALOG.



ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP.
167 Park Ave., Worcester 2, Mass.
Please send Bulletin 410-5 to:

Name .....

Company .....

Address .....

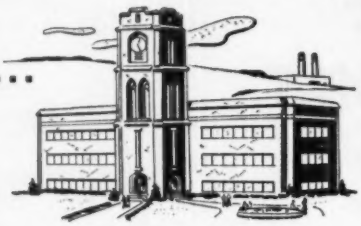
CORAVOL BOILER

CORAVOL CASE HISTORY NO. 4

4th in a series describing CORAVOL results in steam systems

Type of Operation...

STATE COLLEGE



OPERATING CONDITIONS: Evaporation—300,000 lbs. per 24 hours.
Make-up—10%.
Steam and return lines: 4" to ½"—6,000 ft.

PROBLEM: Active corrosion in lines of steam system. Extensive replacement of lines and fittings.

CORAVOL STARTED: September 1939.

RESULTS: Corrosion arrested and no further deterioration of metal.

USER COMMENTS: Initial heavy discharge of rust into the condensate, which gradually cleared up, leaving the condensate permanently free of rust, indicating that no further corrosion is occurring.

STOP CORROSION IN YOUR STEAM SYSTEM

with **CORAVOL** (the original* AMINE PROCESS)

CORAVOL in your steam system (1) prevents corrosion in lines, (2) cleans out clogging rust deposits. Thus, CORAVOL *protects lines;* improves heat transfer; restores original capacity of lines and efficiency of valves and traps.

CORAVOL is *not* a boiler feed water treatment—it is designed expressly for use in steam systems. Because **CORAVOL** volatilizes and condenses with the steam, it circulates throughout your entire steam system and protects *all* zones from corrosive attack.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special formulas of chemical treatment for: boiler feed water . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply . . . soot removal.

*The use of CORAVOL in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

WRITE TODAY for complete free data about the CORAVOL process.

WESTERN CHEMICAL COMPANY

713 Washington Street — Kansas City 6, Missouri

ELECTRONICS

(*Continued from page* 128)

inside the recorder. The measuring cell M connects through resistor R_1 to the ends of potentiometer P. Reference cell R taps into potentiometer P, and connects directly to arm A. This arm is driven by the same motor that positions the recorder's pen.

If check switch S is open as in Fig. 3, measuring cell M is disconnected, which is equivalent to dense-smoke conditions. Only reference cell R is now in circuit. Current flows from − on this cell to arm A, to tap B and to + on R. Another circuit is from arm A down through the lower half of P, part of resistor R_1, galvanometer G, back to + on cell R. This causes the galvanometer to deflect—say, down and against contact C_2 to close a circuit that actuates the recorder.

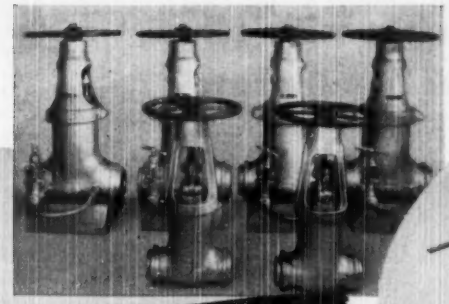
The recorder's motor drives its pen towards dense-smoke position and arm A toward B. When A approaches B, as in Fig. 4, the recorder's pen has been correctly positioned. Current through G is too small to hold contact C_2 closed and it opens to stop the recorder.

Closing switch S, as in Fig. 4, practically cuts reference cell R out of circuit so only M is active. Assume this cell operates on a clear stack, current then flows up through galvanometer G to E on resistor R_1 and to + on cell M. The galvanometer deflects upward, closes contact C_1 to start the recorder motor moving its pen toward clear-stack position.

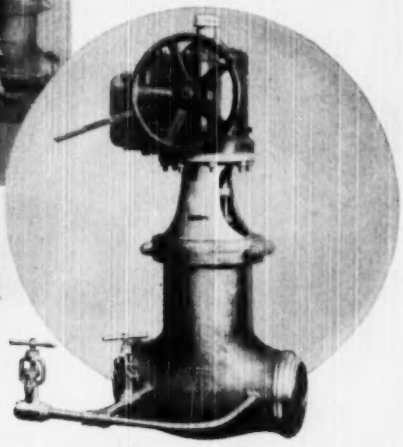
Arm A also rotates counterclockwise, away from B. When arm A reaches a position such as D, cell R applies a voltage downward through the galvanometer equal to that applied upward by measuring cell M. Current then ceases to flow through the galvanometer and its pointer breaks contact with C_1 to stop the recorder's pen in clear-stack position. Voltages of the two cells are now in balance across the galvanometer.

If smoke density increases, voltage of measuring cell M decreases. Voltage of reference cell R is now higher than that of M and a current flows downward through the galvanometer, which is deflected downward as it was in Fig. 3. The recorder starts and moves its pen and arm A toward dense smoke position.

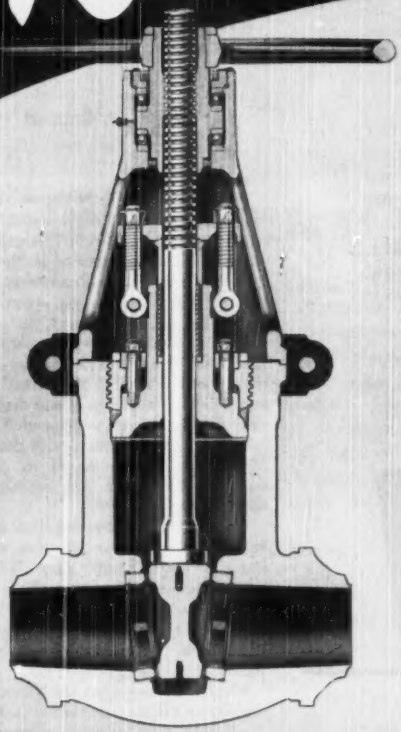
When arm A moves far enough, so voltage applied to the galvanometer by R again equals that from M, the galvanometer centers and stops the recorder at a position corresponding to smoke density. A decrease in smoke density produces a reverse effect to that just explained. So the recorder gives a continuous record of the changes in smoke density. The recorder may be equipped with a signal light and alarm



INSTALLED in South Carolina Power Company's Plant Hagood, No. 2 Unit, at Charleston, S. C.



R·P&C



Pressure Seal Bonnet

THESE CAST STEEL gate, globe and angle valves, for use especially in high pressure, high temperature steam service, are being used increasingly for less difficult services. They offer these advantages:

1. Elimination of bonnet flanges, bolts and gaskets.
2. Tightness unaffected by temperature changes.
3. No need to restress bolting to maintain tight joint.
4. Disassembly and reassembly greatly simplified, should inspection be required.
5. Greatly reduced weight without loss of strength. Less space required. Erection simplified.
6. Insulation is facilitated and neater appearance is given to installation.

FOR COMPLETE INFORMATION, get in touch with our District Office nearest you.

ACCO

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

TRADE MARK

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

READING-PRATT & CADY VALVES

. . . Having trouble with oil in Steam Condensate?

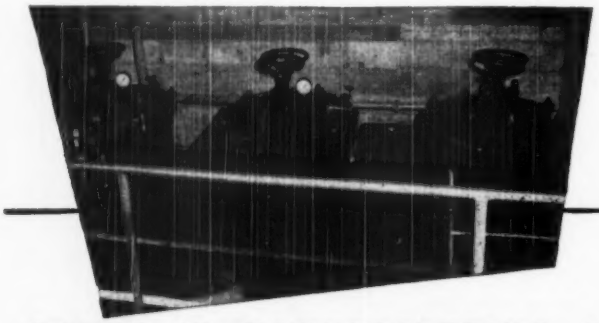
THE SPARKLER PROCESS

. . . reduces oil down to less than .25 p.p.m. in return condensate, the lowest of any commercial process, by employing Sparkler filters, together with other equipment.

This process is engineered to your requirements and our installation service men will be on the job to see that it works to both your and our complete satisfaction.

Write Mr. K. L. Carr, Sparkler Mfg. Co., Mundelein, Illinois for estimate of the cost of an installation for your power plant.

Filters used in one installation of this process that provides a flow rate of 200 gallons per minute.



SPARKLER MANUFACTURING CO.
MUNDELEIN, ILLINOIS
Makers of industrial horizontal plate filters for over a quarter of a century

bell to give warning of objectionable smoke density.

Clear Stack. Resistor R_1 adjusts the zero or clear-stack position of the recorder pen. Moving contact E toward S causes the pen to move nearer the chart's center before it comes to rest on a clear stack. Moving E toward potentiometer P causes the pen to stop farther away from the chart center.

Permanent chart records of smoke density from stacks are important to the plant operator in controlling smoke from stacks. They are also valuable in settling disputes about smoke violations between city smoke inspectors and plant management. Recorders are available on which duration of any smoke violation is read to an accuracy of 6 sec.

In addition to the companies mentioned, others contributing data on smoke-density indicators and recorders include Weston Electrical Instrument Co, Preferred Utilities Co, Combustion Control Corp, The Refinery Supply Co, T W McNeill Engineering Equipment Co and Worner Electronic Devices.

The next article will deal with electronic flame-failure protection for boiler furnaces.

Tube-Film Deposit

(*Continued from page* 101)

phosphoric acid.

3—Displacing With Nitrogen. A second highly effective displacement fluid has been nitrogen. Table VI carries the results of nine treatments in the field using this medium. Procedure Table top of page 99 shows the correct procedure for a field treatment.

In the laboratory we displaced the acid with nitrogen following the 4-hour immersion in acid of the metal specimen. But not all the acid was displaced only enough to free the suspended specimen from direct contact with the acid. Then the specimen stayed in contact with the acid vapors and the nitrogen for an hour.

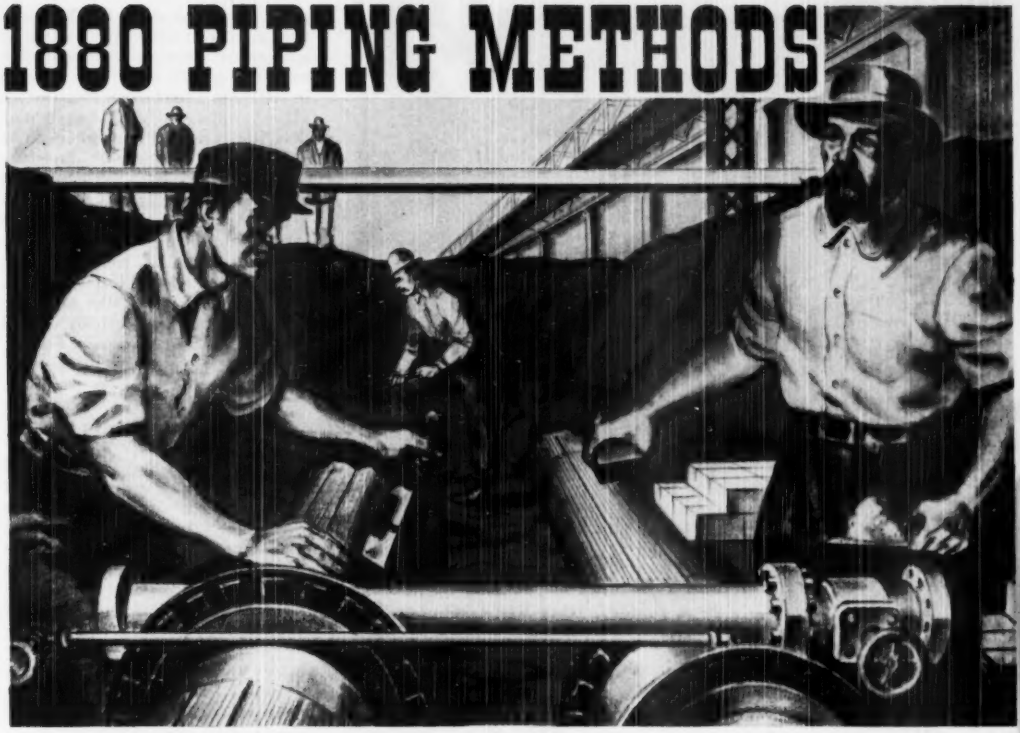
Additional nitrogen dispelled all the remaining acid. The gas gave way to water for the first water rinse. Nitrogen then displaced the water. The metal specimen was allowed to stand in the vapors for another hour in the presence of nitrogen. We repeated the procedure for the second water rinse.

Finally we displaced the vapors and the nitrogen with an after-boil solution. We boiled it for an hour, removed the metal specimen, and dried it in the air. No air touched the metal surface until this point.

With this test, the deposit that formed on the metal surface amounted to 0.08 grams per sq ft following a 1% soda-ash after-boil.

While the displacement technique of

1880 PIPING METHODS



WERE FINE IN THE EIGHTIES

Back in the days when the steeple of Trinity Church and the twin spires of St. Patrick's Cathedral were the tallest structures in New York, one of the greatest obstacles to successful transmission of process and heating steam was satisfactory piping insulation. Since those first underground steam mains, which were enclosed in wooden boxes filled with sawdust, demands for operating efficiency have increased tremendously.

Since 1910, Ric-wiL Prefabricated Insulated Piping Systems have been constantly developed and improved until today they provide users with the world's finest insulated piping for transmission of hot or cold liquids and gases.

Ric-wiL HEL-COR Insulated Piping, in 21-foot prefabricated and sealed sections, provides maximum protection and thermal efficiency.

Ric-wiL FOILCLAD Insulated Piping, also prefabricated in 21-foot sections, gives high thermal efficiency and maximum weather resistance to all types of corrosive atmosphere.

Ric-wiL Prefabricated Accessories make possible exceptional installation economies.

Ric-wiL representatives will be glad to supply detailed technical information on your specific problems.

For full technical information on Ric-wiL Insulated Piping Systems, call or write the Ric-wiL office nearest you or Department 5-HA in Cleveland, Ohio.

40th YEAR DEPENDABLE INSULATED PIPING SYSTEMS 1910-1950

RIC-WIL
INSULATED PIPING SYSTEMS

OVERHEAD — THE RIC-WIL COMPANY · CLEVELAND, O. — UNDERGROUND

FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS

Hewitt-Robins Conveyor Belting Lasts Longer Because It's Matched to the Load

Over the years, belt conveyor operators have found it's false economy to "cut corners" on their belting. The best belting they can buy has always proved the best buy . . . in extra months or years of service, freedom from repairs and ease of maintenance.

And what's "best" for one materials handling job isn't always best for another. That's why we make three types of belting: Maltese Cross® for the hardest, toughest jobs; Ajax® for general service, and Conservo® for lighter applications and portable conveyors.

Hewitt-Robins belting is especially treated to resist the destructive action of moisture and mildew. High grade frictions and a liberal skim coat insure against ply-separation. Abrasion-resistant covers are made of extra tough rubber. Rigid-edge construction prevents curling . . . insures true troughing. And heavy textile reinforcement provides great strength with high flexibility.

There's a Hewitt-Robins conveyor belt for every bulk materials handling assignment, below and above ground. For the best buys in belting, call your Hewitt Rubber distributor (listed under "Rubber Products" in the classified 'phone book) or, write Hewitt Rubber Division, 240 Kensington Avenue, Buffalo 5, N. Y.

HEWITT-ROBINS
CONVEYOR BELTING

HEWITT-ROBINS HR **INCORPORATED**

BELT CONVEYORS (*belting and machinery*) • BELT AND BUCKET ELEVATORS • CAR SHAKEOUTS
DEWATERIZERS • FEEDERS • FOAM RUBBER PRODUCTS • FOUNDRY SHAKEOUTS
INDUSTRIAL HOSE • MINE CONVEYORS • MOLDED RUBBER GOODS
RUBBERLOKT ROTARY WIRE BRUSHES • SCREEN CLOTH • SKIP HOISTS • STACKERS
TRANSMISSION BELTING • VIBRATING CONVEYORS, FEEDERS AND SCREENS

acid-washing using water or nitrogen gives good control of the iron-oxide film, there are still more problems to solve on the material for the best after-boil solution. They are: (1) Solution should cause no additional after-rusting. (2) A sufficient protective coating should be laid down so no after-rusting occurs during outage. (3) Protective coating should undergo no change when the boiler goes into operation. (4) Protective coating should produce no troubles in conditioning the boiler water.

Alkaline materials and phosphoric acid solve the first of these problems. Alkaline materials have the advantage because there is no possibility of acid hideout following acid-washing. Further, the alkaline causes no additional after-rusting no matter what the concentrations. Phosphoric acids, on the other hand, must be sufficiently neutralized or more after-rusting will occur.

A number of chemicals used as after-boil solutions give a protective film that prevents rusting during outage. The best found by our tests was phosphoric acid. Others almost as good were chromic acid, sodium chromate, sodium tripolyphosphate.

Magnetic iron oxide (Fe_3O_4) film qualifies as a coating that would not change composition when the boiler went into operation. Any phosphate or chromate (may be a ferric-chromic oxide) would undergo a chemical change. Such alkaline materials as sodium tripolyphosphate, caustic soda, trisodium phosphate and soda ash for after-boil solutions give the desired film.

Some difficulty has developed in conditioning boiler water after acid-cleaning. Usually it occurs where soda ash is the after-boil material. Trisodium phosphate as the after-boil material helps solve this problem.

But even though some evidence has been built up on the right kind of after-boil material, there still remains a lot to be done. American Gas and Electric Service Corp and the Dow Chemical Co have begun studies toward obtaining the needed information.

Technical Briefs

(*Continued from page* 140)

pany's system. This is more than equal to the total demand of the area when the war started, a demand that took half a century to develop.

This ¾-billion-dollar investment of private capital represents a cost four times that of Hoover Dam and power plant, one and one-half times the estimate for Central Valley Project when completed, two and one-half times Grand Coulee and power plant exclusive of the irrigation system, and more than four times estimate for the proposed

has oxidation resistance unapproached by any other turbine oil!

Now more than ever it's the world's finest! The new improved Gulfcrest has oxidation resistance unapproached by any other turbine oil!

After extra refining by the Alchlor Process, Gulfcrest Oil is enriched with a remarkable new oxidation stabilizer — another important Gulf Research development. This additive greatly improves Gulfcrest's already outstanding chemical stability.

In actual field tests, including systems where oil temperatures are unusually high—and in accelerated oxidation tests in the laboratory, Gulfcrest has outlasted other quality turbine oils.

And—the new improved Gulfcrest Oil has been fortified to provide an even more effective rust preventive film. Now you can be sure that all oil bathed surfaces in your turbine lubricating system can be completely protected against rust. Gulfcrest Oil has highly preferential wetting characteristics—displaces water quickly on the internal surfaces of the system. Then too, Gulfcrest Oil eliminates foaming.

Ask the Gulf Lubrication Engineer for complete details about the new improved Gulfcrest Oil, or write, wire, or phone:

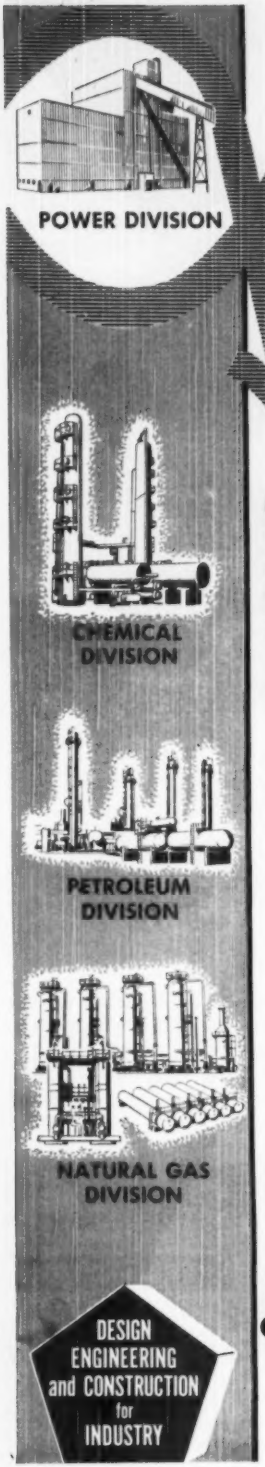
GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation · Gulf Refining Company

GULF BUILDING, PITTSBURGH, PA.

Sales Offices - Warehouses

Located in principal cities and towns throughout Gulf's marketing territory



Pritchard Built POWER PLANTS

Operate Profitably... Efficiently

Every refinement of modern electrical engineering is embodied in this 7500 KW plant recently designed, engineered and constructed by J. F. Pritchard & Co. for Missouri Utilities Co. of Oran, Mo.

Throughout the industry, Pritchard built power plants are known for their sound design, engineering and construction—for operational efficiency and freedom from trouble.

Pritchard's single responsibility contract offers you complete service including Analysis of Requirements, Economic Studies, Design, Engineering, Purchasing, Field Construction, Guarantees and Operating Tests . . . Firm Prices quoted on a "Turnkey" basis.

Take advantage of Pritchard's years of experience in the Power Engineering and Construction field. Let us design and build your next power plant for you.

Write for FREE Bulletins

CONSULTING NATIONAL CONSTRUCTORS ASSOCIATION MEMBER

J.F. Pritchard & Co.

DESIGN • ENGINEERING • CONSTRUCTION

Dept. No. 49 908 Grand Ave., Kansas City 6, Mo.

District Offices:

CHICAGO • HOUSTON • NEW YORK
PITTSBURGH • TULSA • ST. LOUIS

San Francisco Bay crossing parallel bridge and approaches.

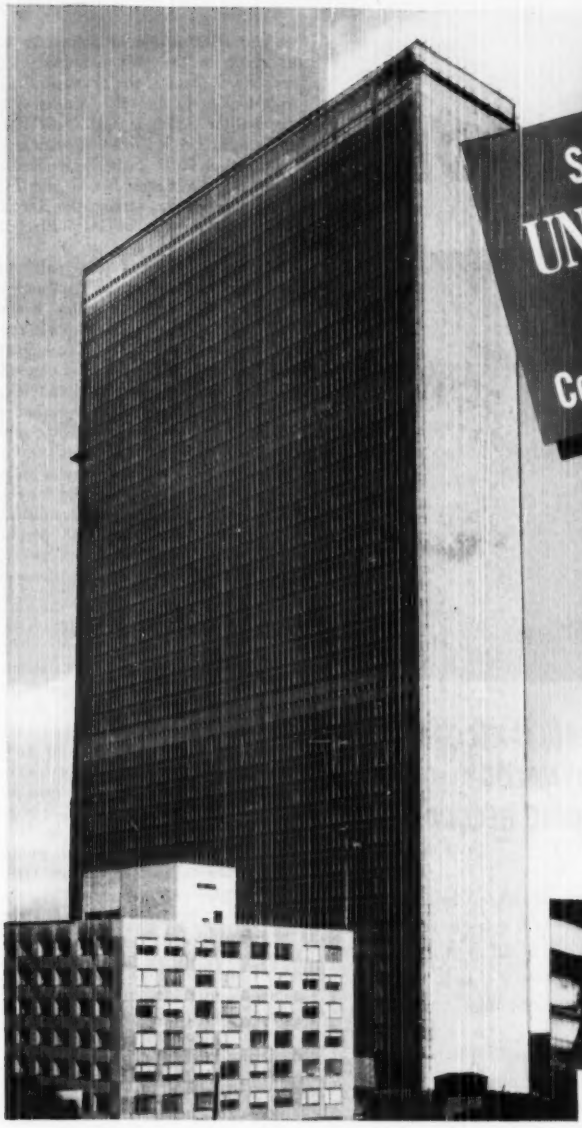
From its beginning in the days of '49 to the present, man-made rivers have been of major importance to the economic life of California. Hydroelectric plants have provided substantial benefits at less cost than equivalent steam power, and have saved the equivalent of many million barrels of oil, which would otherwise have been used each year to generate the same amount of power by steam. By storing surplus water for power plants during the runoff season, and releasing it through the balance of the year, a more substantial flow is maintained in what would otherwise be streams with very little flow or completely dry beds. This is especially beneficial to irrigation and recreational facilities, and many summer resorts owe their existence to this practice.

These plants contribute annually about $4½ million of taxes to local and state governments and an equal amount in income taxes to the Federal government. In 1948, the Pacific Gas and Electric Co paid property taxes to seven counties in California ranging from 57% of the total taxes for Alpine to 22% for Calaveras. *ASCE paper. No number.*

WHEN COMPLETED BIG CREEK—SAN JOAQUIN—PROJECT WILL GENERATE 2¾-BILLION KWHR FOR CALIFORNIA, *by W L Chadwick, Southern California Edison Co.* When construction on San Joaquin-Big Creek project is completed, a total of more than a half-million kw will have been developed and dedicated to public service, capable in an average water year of generating more than 2¾-billion kwhr. Average cost including transmission lines to the load will be about $258 per kw, built without public funds and in spite of tax loads amounting to as much as $25.86 per kw yr, as in 1945, and $14.48 in 1949. There has been no increase in the price of power from the affected system since 1922. Rather, there has been a continuous decrease.

By July 1951, when this project is completed, about 345,000 acre-ft of storage will be provided by private power development for the joint benefit of irrigators and power users. Of this water a large part is available for irrigators when the river is at its lowest stages and at no cost to them. With this development has come the opening up of one of the finest and most popular recreation areas in the Sierra Nevada. Existing San Joaquin River power diversions, combined with the newest now under construction, will utilize nearly 6000 ft of head to produce nearly 4600 kwhr per acre-ft.

First hydroelectric generation was in 1882, near Uplands, Calif., and the first diversion for commercial genera-



Steam For Heating UNITED NATIONS BUILDINGS Controlled by Foster Valves

The UN Secretariat was designed by a board of architects from all over the world, with Wallace K. Harrison as Director of Planning, and is being built for the United Nations by Fuller-Turner-Walsh-Slattery, Inc. Syska & Hennessy were consulting mechanical engineers. Heating, ventilating and air conditioning systems installed by Almirall & Co., Inc.

From the Metering Room in the Secretariat Building, steam from New York Steam Corp. is piped at 140 pounds to galleries on the sixth, sixteenth, and twenty sixth floors. Here it undergoes a two-stage reduction and is then distributed for heating service.

Other buildings in this group will also be served from the Metering Room, and steam pressures will be automatically regulated by Foster Valves.

Foster Representatives in principal cities will be glad to work with you on your regulating problems — without obligation.

For the first stage, Foster Type G single seated, internally pilot operated regulators reduce the pressure from 140 pounds to 50 pounds.

For the second stage, from 50 pounds to 5 pounds, Foster Type J-2 double seated, direct-acting, spring loaded diaphragm valves are used.

FOSTER ENGINEERING Company

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . CUSHION CHECK VALVES . . . ALTITUDE VALVES . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN VALVES . . . VACUUM REGULATORS OR BREAKERS . . . STRAINERS . . . SIRENS SAFETY VALVES FLOW TUBES

835 LEHIGH AVENUE • UNION, N. J.

Now!
A 6 POINT RECORDER
for as little as $100 per point†

THE MULTI-RECORD DYNALOG* ELECTRONIC RECORDER

Economy is only one of the many advantages offered by the Foxboro Multi-Record Dynalog. It makes up to 6 easy-to-read records (with only 1 measuring system)... in 6 different, brilliant, non-running colors. It prints a reading every 6 seconds, giving practically continuous-line records on economical round charts.

The Multi-Record Dynalog is available for measuring temperature, pressure, flow, or any of a wide variety of other process variables. It's an instrument of the highest precision, offering the extra advantages of easy comparison of records and instrument-space economy. Maintenance is practically eliminated because the Multi-Record Dynalog has no slidewire, requires no standardizing, uses no dry cell. Yet it is unmatched in sensitivity, accuracy, and speed of response. Get complete details. Write for Bulletin 427-1. **The Foxboro Company, 68 Neponset Ave., Foxboro, Mass., U. S. A.**

*Reg. U. S. Pat. Off.
†Exclusive of sensitive elements

Another FOXBORO FIRST
Reg. U. S. Pat. Off.

tion and transmission of polyphase ac was made to the still-operating Mill Creek No. 1 plant of the Southern California Edison Co in 1893. Under construction for Southern California Edison Co is Big Creek No. 4 project, which will develop 420-ft head between the tailrace of Big Creek No. 3 and the Kerchkoff reservoir, serving the Kerchkoff plant of the Pacific Gas & Electric Co.

The project consists principally of 250-ft-high concrete gravity dam across the main river about 6 miles below powerhouse No. 3, a 35,000 acre-ft reservoir, two sections of 24-ft diameter tunnel, a short connecting steel conduit 15½ ft in diameter, a single 15-ft all-welded steel penstock, a powerhouse containing two 42,000-kw turbine-generators, and an additional 230-kv transmission circuit to the Los Angeles area. More than 38% of the concrete for the dam has been placed. May a political climate be preserved that will permit such developments in the public interest to continue. *ASCE paper. No number.*

Fluids and Pumping

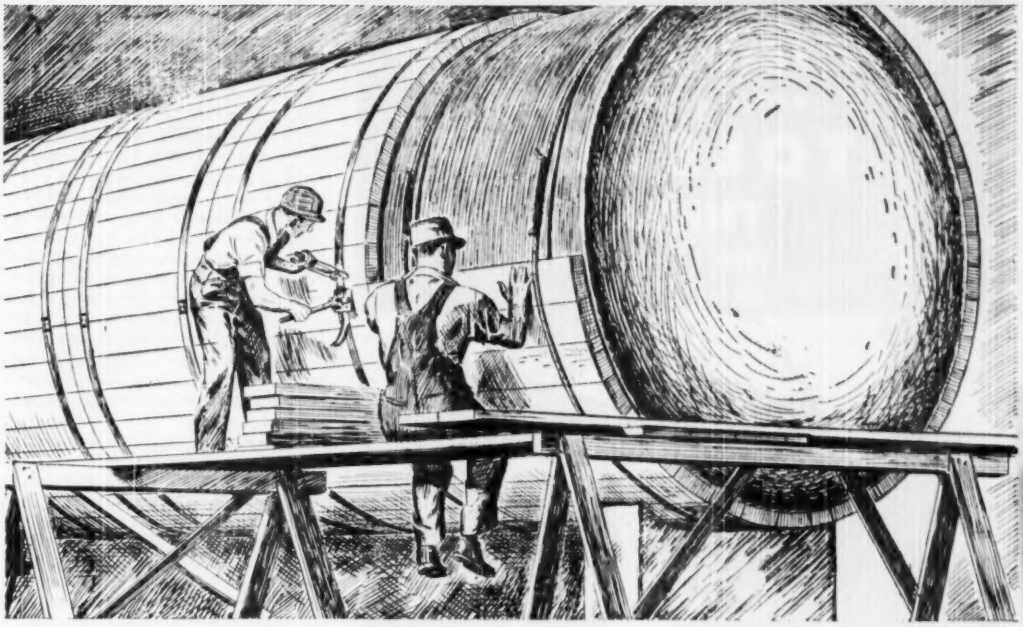
THE BERRY HYDRAULIC TRANSMISSION, *by A G Holmes, Jr, Mississippi State College and C D M Varnado, Berry Motors, Inc.* The positive-displacement rotary pump has been used for centuries, but power requirements have been so low or the service rendered so intermittent that little attention has been paid to attaining high efficiencies.

Simplest positive-displacement pump of recent design is the external spur gear unit, which may be converted into a motor by supplying it with a high-pressure fluid. A combination of rotary pump and rotary motor opens up a new field for possible exploitation—one that involves continuous transmission of power in comparatively large amounts.

The most elementary Berry pump or motor consists of two pumping elements each with an abutment valve and a piston rotor. The two elements are displaced axially at a convenient distance. Each piston rotor carries a single piston of fixed length. Piston rotors and abutment valves key to parallel shafts. These shafts are geared together to give a proper relative motion. Fig. 2 shows arrangement of the major elements.

Tests so far on Berry hydraulic motors show the torque remains constant at constant pressure regardless of speed up to the highest speeds at which tests have been made. Torque varies directly as the imposed pressure on the motor unit. *ASME paper, Oil and Gas Power Div. Meeting, Baltimore, Md. June, 1950. No number. With ASME, 29 W 39th St, New York 18, N. Y.*

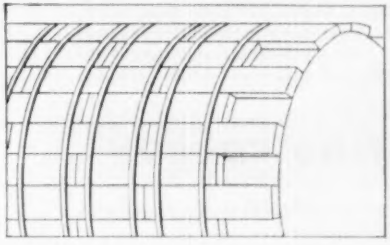
(Continued on page 176)



What's wrong with this picture?

Applying 85% Magnesia Block to an outdoor tank the way these men are doing it may lead to future trouble. They're banding the insulation on in regular courses instead of staggering the blocks. This will not cause appreciable heat loss, but it will focus the effects of expansion and contraction on definite circumferential lines. Eventually the weatherproof finish will crack all the way around the tank along the line where the ends of the insulation blocks butt together.

The way to guard against this failure is simply to stagger the insulation block for block, as shown in the small drawing at the bottom of page. These interlocking courses distribute the strain of expansion and contraction evenly among all the joints, reducing the danger of breaks in the weatherproof finish.



The correct way to line up insulating block is common knowledge with experienced insulation mechanics. They don't make the kind of mistakes that will shorten the life of the work and lessen its efficiency. That's one reason why it pays to have your heat insulation done by a contracting organization like Armstrong, that employs well-trained men to work under experienced foremen and superintendents.

The next time you need any heat insulation work done, why not call in this experienced contractor? Just phone the Armstrong office nearest you or write direct to Armstrong Cork Company, 7007 Maple Avenue, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS - INSTALLATION

FOR ALL TEMPERATURES FROM 300° F. BELOW ZERO TO 2100° F.

A TERRIFIC HIT!
BETTER MECHANICS PREFER
TOLEDO 1R
THREADER
FOR 1" to 2" PIPE
because
It's ACCURATE!
Perfect threads produced by separate Toledo Dies for each pipe size.
It's EASY THREADING!
Less friction due to famous Toledo receding die principle — small die segments with only a few cutting teeth backed by taper pins.
It's LOW COST!
Simple in design with one ratchet handle.

Do your next 1" to 2" pipe work with a Toledo 1R Threader—the tool that's "tops" with better mechanics! Similar to the famous No. 1 and No. 1A Toledos—but *simpler in design* with one ratchet handle and *low in cost!* A separate set of dies for each size of pipe —1", 1¼", 1½" and 2"—assures longer die life. Each set is hobbed for just the proper clearance. This means easier cutting, smoother, cleaner, more perfect threads and tighter pipe joints! Die change is quick and easy . . . or, many users prefer separate tool for each size. Durable . . . saves job-time . . . reduces costs! Ask your distributor for details and price . . . or send coupon.

RELY ON THE LEADER

TOLEDO

POWER PIPE MACHINES
POWER DRIVES
PIPE TOOLS

SEND COUPON

The Toledo Pipe Threading Machine Co.
Toledo, Ohio

Without obligation, send bulletin No. 650 and price on Toledo No. 1R Threaders, 1" to 2" pipe.

Name.....

Firm.....

Street.....

City.....State.....

STANDARDS OF PERFORMANCE FOR HEAT PUMP CYCLES, *by J F Sandfort, Iowa State College.* It has often been pointed out that the heat pump and refrigeration equipment are basically one and the same thing. The implied conclusion is that 50 years of refrigeration-cycle theory and experience can be applied equally well to the heat pump.

To the author, this seems an oversimplification. Refrigeration machinery is used because it is the only way to produce low temperature, and the coefficient of performance inherent with the equipment is accepted because of this fact. The heat pump, however, will always have to compete with other heating systems. The economic possibility of its development to a real commercial product depends on how high the operating coefficient of performance can be raised above unity.

Purpose of this paper is to compare performance of certain actual and ideal cycles now in use with a theoretical maximum. In this way the great disparity that exists can be emphasized.

One typical condition of operation has been selected, examined for performance, and then compared with an ideal vapor cycle. Next are considered the possibilities of improvement in present commercial vapor-compression equipment and the opportunities available through multistaging air cycles, etc. The author raises the point that with present vapor-compression equipment the top is about 3.5. With possible improvement, this could be raised to 5 with present equipment. This is an improvement of 42.2 to 60% when referred to the Carnot cycle. Perhaps, the author says, it may be reasonable to increase further to as high as 6.5. *MWP paper. No number.*

COMPARATIVE COSTS OF FABRICATION OF INDUSTRIAL PIPING, *by Charles Schott, Frank Fehr Brewing Co.* Too often engineers have assumed welded piping offered economies only for large high-pressure plants. They felt that screwed or flanged fittings would prove best for the smaller plant.

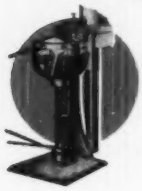
When the author's plant had put a new boiler into operation in a hurry they specified that all lines over 2 in. be welded, except for city water. They timed different welders, switched from job to job, size to size, so time records would be accurate. The same procedure was followed for threaded and flanged lines.

Tests showed no leaks in the welded lines but several in the threaded ones. Repairs and corrections were charged against the installation cost. Some times the additional expense amounted to 15% of the original piping cost.

The author highlighted his paper by a piping diagram of a steam-distribution system in his concern's new bottling

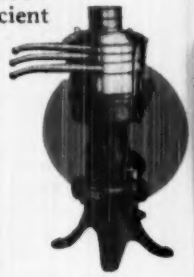
WHIRLING MILESTONES

De Laval today offers a centrifuge for every purification need in the power field. Back of every recommendation stands nearly three-quarters of a century of being ***first*** in major centrifugal developments.



1878 Carl Gustav De Laval invented the first continuous Cream Separator. He tried tubular bowl design.

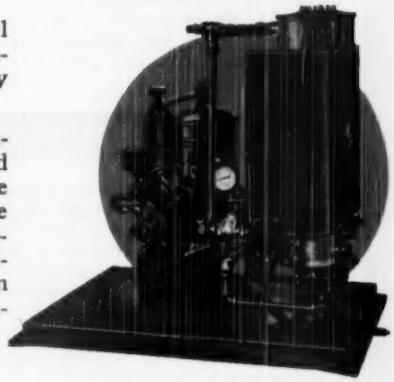
1890 Dr. De Laval abandoned tubular bowl, invented slower-speed disc bowl to stratify liquid for more efficient purification.



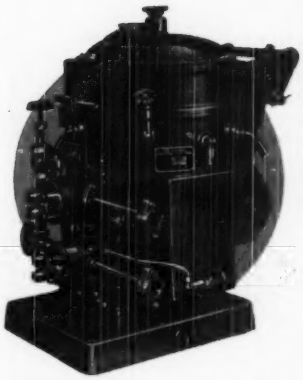
1918 First centrifugal Oil Purifier introduced by De Laval. This continuous Oil Purifier was driven by a small steam turbine.

1922 First De Laval centrifugal Insulating Oil Purifier installed. In 1950, the centrifuge is still the safest way to maintain insulating oil because water, once discharged, cannot recontaminate the dry oil.

1950 Full range of "Uni-Matic" Oil Purifiers now available, including No. 67 with a capacity of approximately 450 gph.



De Laval "Puri-Filter," combining centrifugal force and filtration, makes possible the removal of fly ash or moisture haze as well as more dangerous impurities. The "Puri-Filter" is the ultimate in turbine or engine oil lubrication purification.



THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL
OIL PURIFIERS

for most dependable power production

Where You'll Find Proof Of The Experience Behind . . .

BOILERS BY BIGELOW

Some Typical Installations of Boilers By Bigelow

THE STANLEY WORKS, New Britain, Conn.
50,000 lb. per hour . . . oil fired

A. G. SPALDING & BROS., INC., Chicopee, Mass
40,000 lb. per hour . . . oil

STANFORD UNIVERSITY, Palo Alto, Calif.
40,000 lb. per hour . . . oil & gas

ST. MARY'S SUGAR, Sorel, Le.
45,000 lb. per hour . . . bagasse

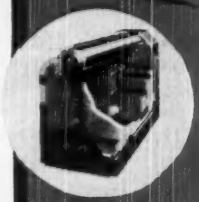
BARTGIS BROTHERS, Ilchester, Md.
60,000 lb. per hour . . . coal

GENERAL E. L. LOGAN AIRPORT, E. Boston, Mass.
65,000 lb. per hour . . . oil

CHINA AMERICAN PAPER CO., Shanghai, China
20,000 lb. per hour . . . oil

INTERNATIONAL SILVER CO., Wallingford, Conn.
30,000 lb. per hour . . . oil

PETER PAUL, INC., Philippine Islands
12,000 lb. per hour . . . coconut husks



Throughout industry, Bigelow boilers are piling up service records of efficient steam production. Each successful installation is further evidence of Bigelow's boiler-making experience. Each is operating proof of Bigelow's ability to build boilers to answer a wide range of steam requirements.

Every one of the hundreds of Bigelow boilers holding down vital power jobs is another reason for you to consider Boilers By Bigelow for your plant.

Write for free catalogs on any of the units listed here.

BOILERS BY BIGELOW
Water Tube Boilers — Bent Tube Types
Horizontal Return Tubular Boilers
Scotch Type Boilers
Two-Pass Boilers
Electric Steam Generators

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.
Established 1833

BIGELOW REPRESENTATIVES: Boston • New York • Philadelphia • Syracuse • Detroit • Chicago • Pittsburgh • Milwaukee New Orleans • Baltimore • Petersburg, Va. • Washington, D. C. Albuquerque • Seattle • Sumter, S. C.

plant. A comparison was shown between bids for welded and threaded pipelines. On top of these bids are those for insulation for both types.

The author feels the lower maintenance costs for a welded system against a threaded one should carry considerable weight in selecting an initial installation. *MWP paper. No number.*

GASKETS AND BOLTED JOINTS, *by Irving Roberts, division engineer, process div, research and development, Elliott Co.* A study of loading requirements of gaskets in bolted joints, with the object of developing a rational basis for design of such joints. Starting with an analysis of gasket conditions for tightness, the gasket factor "m" is defined, and its variation with initial gasket stress and gasket width is predicted. A survey of available literature data confirms these trends.

In a bolted joint, gasket stress becomes a function of the elastic constants of the system. Equations are derived to predict gasket and bolt stresses resulting from application of internal fluid pressure. Typical elastic recovery curves for an asbestos gasket are presented. Consideration is given to the effect of gasket creep in a bolted joint, and to the problem of distribution of bolt load, for which an approximate theory is derived.

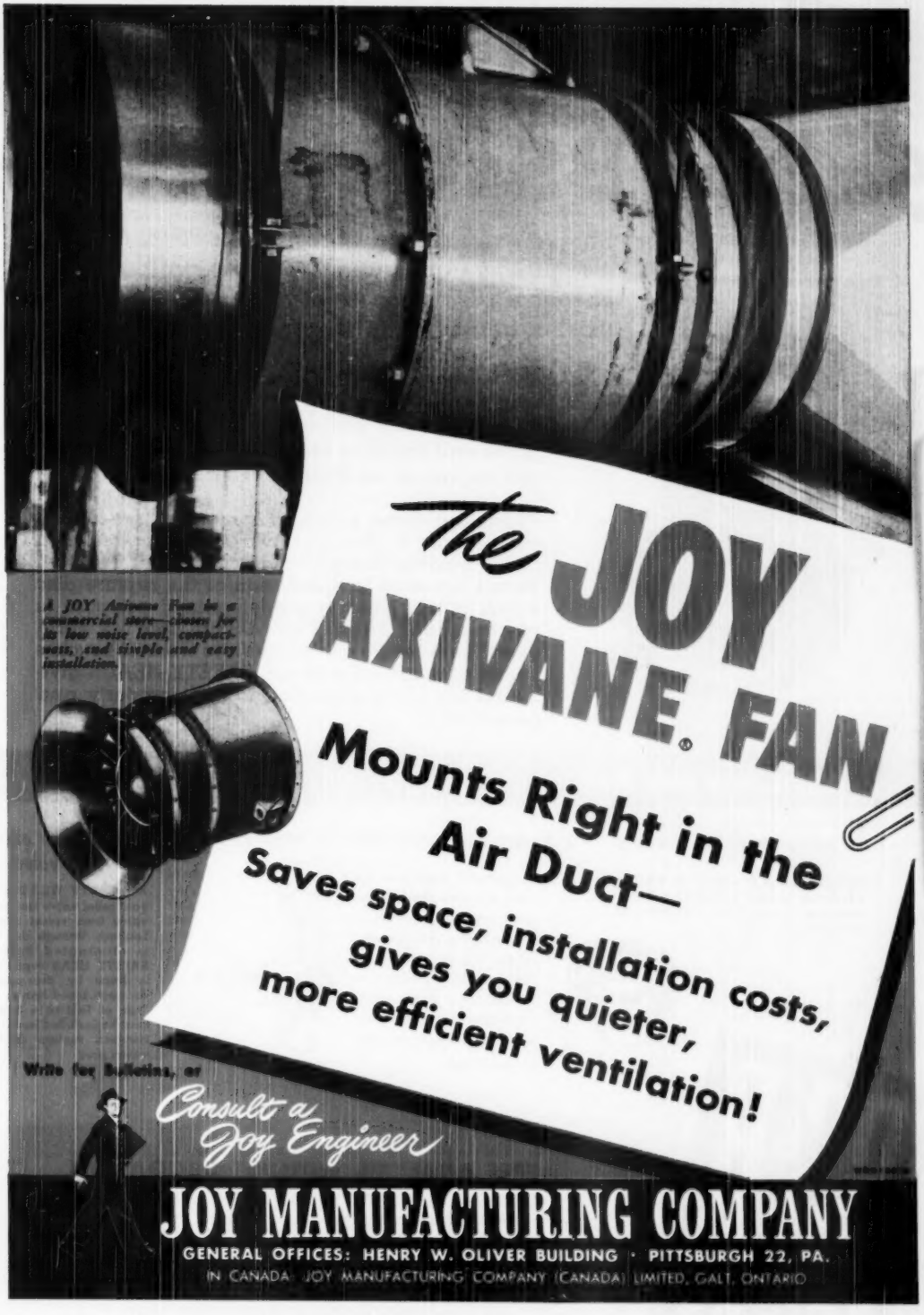
Defects in *ASME Code* are pointed out, and a tentative new design procedure is proposed. Finally, a summary of data, which should be obtained for use with this procedure, is given. *ASME paper No. 49-A-2.* 29 W 39 St, New York.

Water Treatment

DEMINERALIZATION AS COMPARED WITH EVAPORATION OF MAKEUP FOR SURFACE CONDENSING POWER PLANTS, *by J D Yoder, vice-president, The Permutit Co.* Satisfactory operation of high-pressure boiler plants demands good control of boiler water treatment and chemical softening or demineralizing equipment. This paper compares the economics of using demineralization instead of evaporators for boiler feed makeup. A true evaluation in dollars and cents must be based on operating conditions as determined by the design and operating engineers.

As with chemical treatment, demineralizing cost depends on total solids in the raw water. But the demineralized product, having substantially the same constituency of evaporated water, offers boiler feed makeup without energy loss from degrading heat, according to the author. Accompanying tables give the analysis of demineralized, evaporated and concentrated boiler water. *MWP paper. No number.*

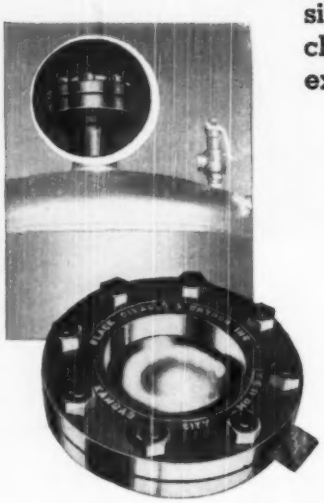
(Continued on page 181)


The JOY AXIVANE® FAN
Mounts Right in the Air Duct—
Saves space, installation costs, gives you quieter, more efficient ventilation!
A JOY Axivane Fan is a commercial store—chosen for its low noise level, compactness, and simple and easy installation.
Write for Bulletins, or
Consult a Joy Engineer
JOY MANUFACTURING COMPANY
GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.
IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

Problem: Venting a dangerously

Solution: BS&B SAFETY HEADS

Should external fire exposure—a sudden excessive pressure generation—or an internal fire and chemical reaction get out of hand—would your existing relief valve meet such an emergency?



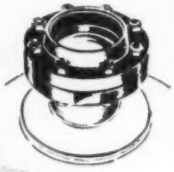
BS&B SAFETY HEADS are the solution for dangerously fast pressure rises. They give INSTANT RELIEF! A fully unrestricted opening is made for gases and liquids to escape. No other relief device acts as fast as the BS&B SAFETY HEAD.

There are three principal parts... a pre-formed metal rupture disc and two specially designed metal holding flanges. Correct element resistant metals are used in fabrication of the rupture disc which bursts when a predetermined pressure is reached. BS&B SAFETY HEADS are used the world over. There are no moving parts to wear or become fouled at a critical moment. SAFETY HEADS give 'round the clock protection to both property and personnel.

Here Are the Answers to Your Relief Valve Problem

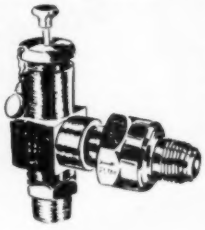
1. As sole pressure relief device

This installation is used when it is not necessary to have a shut-off or when materials handled are not toxic or inflammable.



2. At outlet of certain types of relief valves

A SAFETY HEAD at the relief outlet will stop leakage until rupture disc pressure is attained. Not recommended where viscous or corrosive materials might contaminate internal parts of the valve. Investigate your valve design before using this type of installation..



3. Under your existing relief valve

A SAFETY HEAD under your relief valve isolates the valve from vessel contents. Leakage through the valve is eliminated until the SAFETY HEAD rupture disc is burst by over-pressure. An open bleed line or some type of tell-tale indicator must be installed in chamber between rupture disc and valve plug.

BS&B SAFETY HEADS

FREE ANALYSIS WITHOUT OBLIGATION

Jim Myers, BS&B SAFETY HEAD Sales Manager will have a BS&B engineer analyze your pressure relief problems and submit suggestions to you WITHOUT COST OR OBLIGATION. Mail the coupon on opposite page or call GRand 6700, Kansas City. Do it now!

BLACK, SIVALLS & BRYSON, INC.

KANSAS CITY • TULSA • OKLAHOMA CITY

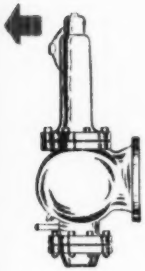
fast pressure rise...

FOR SAFETY'S SAKE

Mail Coupon for Your Copy of This Book

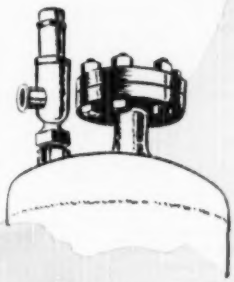
Get all the facts... all the answers to your questions about BS&B SAFETY HEADS! The latest up-to-the-minute information on the use of BS&B SAFETY HEADS in the Chemical Industry is contained in a new catalog. You will receive a copy by mailing the coupon below to Black, Sivalls & Bryson, Inc.

Extra Protection for Expensive Equipment



4. As a secondary relief device

When the SAFETY HEAD is used as secondary relief device you are given positive protection when pressure rises to the predetermined bursting pressure of the rupture disc. The primary relief valve may fail to function due to corrosion, or if pressure continues to rise, due to inadequate relief area.



BLACK, SIVALLS & BRYSON, INC.

720 Delaware, Sec. 4-6-7, Kansas City, Mo.

☐ Please send me a copy of the new BS&B SAFETY HEAD catalog.

☐ Please have a BS&B SAFETY HEAD engineer analyze my relief problem, without cost or obligation to me.

Name_____

Firm_____

Title_____

Address_____

City_____ Zone____ State_____

WATER TREATMENT FOR MODERN ELECTRIC UTILITY-PLANT INSTALLATIONS, *by F G Straub, University of Illinois.* Modern electric utility plants have made use of the unit system of one boiler-one turbine in a number of instances. This selection requires boiler service equal to turbine, which means there should be no operating interruptions because of metal failures in the steam-water portion of the cycle. One method to assure such operation is feed treatment.

Unfortunately, many feel that if the chemicals used are in soluble excess in the boiler water there'll be no trouble. In larger stations it is necessary to control this excess and to reduce the initial contaminating materials to as low a point as possible. Particular attention is directed to hardness (calcium and magnesium) iron, copper, silica and oxygen.

The author discusses how these contaminants get into the initial water and then gives methods for removal or control. Emphasis in new plants is on supplying the purest-type water. To be certain the water continues at the required high grade, methods of analyses had to be worked out for detecting small amounts of hardness, silica and oxygen. These methods are now in use, particularly since the versenate method of hardness determination became available. *MWP paper. No number.*

PREVENTION OF DEPOSITS IN CLOSED FEEDWATER HEATERS AND ECONOMIZERS, *by W S Kane, Iowa Public Service Co.* The Kirk Station of the author's company operates at 700 psi for electrical energy generation and exhaust steam for office-building and store heating. Its makeup runs close to 80%.

Well water and raw water average a hardness of 400 ppm as $CaCO_3$. Hot lime-soda softeners treat this incoming makeup and then pass it through mechanically and chemically deaerated tanks before admitting it to the high-pressure feedwater system.

Before sodium aluminate was used as a supplement to the softeners, hardness of treated water ran 12.0 ppm as $CaCO_3$. Now it runs 7.0 ppm.

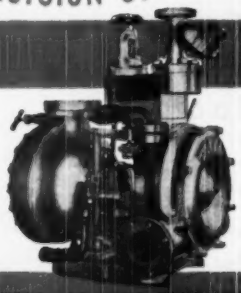
Serious fouling in a closed feedwater heater dropped feedwater temperature from 350 F to 325 or less in 25- to 30-day intervals. So frequent manual and acid cleaning were employed. When additional feedwater heaters were to go in, fouling was thoroughly studied.

A processed lignin derivative was applied to the feedwater from the closed feedwater heater at dosage rate of about 4 to 5 ppm based on total boiler feedwater. Before the lignin was used the plant could operate a heater about 600 hr and then temperature would fall off rapidly by as much as 25 degrees. With lignin they run 7200 hr before needing cleaning. *MWP paper. No number.*

(More "Technical Briefs" on p 214)

COFFIN

Turbo Pumps Deliver 3-to 12-Stage Pump Performance



CHECK THESE PERFORMANCE FEATURES FOR YOUR NEXT JOB...

COFFIN PUMP REPRESENTATIVES SERVE ALL OF AMERICA'S INDUSTRIES

L. O. Arningdale, New York, N. Y.
Robert Bacon Company, Newton, Massachusetts
Beeson Bros. Engineering Co., Los Angeles, California
Stuart D. Brown, Sewickly, Pennsylvania
The H. Berry-Detroit Company, Detroit, Michigan
Cordes Brothers, San Francisco, California
J. M. Costello Supply Co., Wilmington, California
John N. Fehlinger Co., New York, N. Y.
Fuel Economy Engineering Co., Saint Paul, Minnesota
J. W. Himmelsbach, Chicago, Illinois
International Railway Supply Co., New York, N. Y.
C. E. Johnson & Associate, Atlanta, Georgia
William F. Lewis, Kenmore, New York
Maleson Company, Philadelphia, Pennsylvania
John H. Marvin Co., Seattle, Washington
John H. Marvin Co., Portland, Oregon
The O'Fallon Co., St. Louis, Missouri
Charles Ostertag, Indianapolis, Indiana
Henry P. Thompson Co., Cincinnati, Ohio
P. Thompson Tool & Supply Co., Houston, Texas
Frank D. Riggio Co., Rutherford, N. J.
Seaboard Equipment Co., Yarmouth, Maine
William P. Little, Bridgeport, Conn.
Warren M. Wilson Co., Cleveland, Ohio
Marine Specialty Co., Mobile, Alabama
P. Thompson Tool & Supply Co., New Orleans, Louisiana

FREE

A complete 4-page illustrated bulletin on COFFIN TURBO PUMPS with all operating data, applications, specifications, that you may require for your next job. Write for Bulletin "S" today.

165

COFFIN

The J. S. COFFIN, JR., COMPANY

326 SOUTH DEAN STREET, ENGLEWOOD, NEW JERSEY

EQUIPMENT NEWS

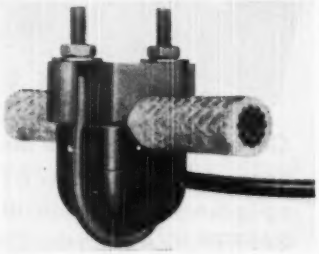
(*Continued from page 158*)

SELF-LUBRICATING BEARINGS P760

Carbon bearings operate at temperatures up to 800 F without lubrication. Ability to function at high speeds under heavy loads makes them particularly well adapted to steam pumps, turbines, industrial ovens, and in installations where bearings are inaccessible and maintenance is difficult.

Bearings have high resistance to corrosion, chemical attack, and have high mechanical strength. Self-lubricating bearings are applicable to seals, rings, slides and valves.

Morganite Inc, Carbon Specialties Div, 3304 48th Ave, Long Island City 1, N.Y.



CABLE CONNECTOR P765

Snaptap is safe for jobs calling for connecting to "hot" lines. Tap is made without stripping the main-line insulation or exposing the copper. Device accommodates 350,000 to 800,000 cm cable and No. 14 to No. 6 branch wires. Connector is approved by the Underwriters.

Gemmer Mfg Co, 6400 Mt. Elliott, Detroit 11, Mich.

SOLDER INDICATOR P717

Portable, direct-reading tin-content indicator determines ratio of lead and tin in solder. Lead alloys with tin content up to 7% may be tested in a matter of seconds.

Indicator consists of a high-resistance pyrometer and a plug-in sensing unit connected to an indicating meter. Instrument is calibrated in divisions from 0 to 7% representing the tin content.

Wheelco Instruments Co, 847 W Harrison St, Chicago 7, Ill.

MIXING TANK P723

Heavy-gage steel, 53-gal agitator tank for boiler feedwater-treatment solution mixing in 22-in. ID with 36-in. over-all height. Hand crank is provided for agitating the solution and heavy perforated-steel chemical basket is supplied.

Dearborn Chemical Co, 310 S. Michigan Ave, Chicago 4, Ill.

DC POWER SUPPLY P768

Model 315 features one regulated B supply, one regulated C supply, and one unregulated filament feed. Unit has good

FORCED BOILER OUTAGES TURBINE SANDBLASTING, ELIMINATED!

BEFORE Allis-Chalmers Silica Removal Service	**AFTER** Allis-Chalmers Boiler Feedwater Service Installed
57 Boiler shutdowns in 33 months with 834 boiler hours of unscheduled outage.	Boilers and turbines operate 14 months between scheduled cleanings!
133 Tubes replaced. 29 Tubes welded.	*No* boiler tube failures!
Turbines sandblasted every 4 months.	*No* turbine sandblasting!
Power Production down 50% before each cleaning.	Rated power capacity is maintained!

ACTUAL CASE!

SILICA REDUCTION IN BOILER FEEDWATER with Allis-Chalmers chemicals and treatment produced these startling power plant economies at the Southern Advance Bag & Paper company, Hodge, Louisiana.

One of the leading manufacturers of paper bags in the south, this company has a daily steam production average of 9,350,000 lbs from 10 boilers serving 5 turbines generating 12,000 kw, a number of turbine-driven auxiliaries, and turbines operating paper machines.

Raw water analyses taken over a period of three years at Southern Advance show a silica reduction of 94% due to the use of Allis-Chalmers chemicals.

You can get similar results from A-C water conditioning service, chemicals and equipment.

Whatever your industry — paper, petroleum, food, steel — you'll get prompt, convincing results with Allis-Chalmers water conditioning service. An expert representative is available, ready to recommend proper chemicals or help select the right process for your power plant requirements.

Get in touch with him today at your Allis-Chalmers Office for complete information.

JOHN B. DAVIS, with 15 years experience in power plant water conditioning, is one of the A-C specialists located around the country to advise you of correct water conditioning equipment, chemicals and service.

ALLIS-CHALMERS

Water Conditioning

✓ EQUIPMENT ✓ CHEMICALS ✓ SERVICE

ALLIS-CHALMERS, 952A SO. 70 ST. MILWAUKEE, WIS.

Gentlemen:
Please send me specific information on A-C chemicals for feedwater treatment.

Name

Title

Company

Address

City State A-3070

5 Reasons
STRONG* 70 Series Traps
give better service!

Look to these five reasons for long, trouble-free service in STRONG 70 Series Traps:

1. *Valve and seat guaranteed leakproof for one year—made of STRONG's patented, wear-resistant Anum-Metl;*
2. *Easy servicing—permitted by the renewable seat design, cover with all working parts easily removed without breaking pipe connections;*
3. *One piece bucket—stainless steel, no welds;*
4. *Turbulence avoided, choking minimized, 25% greater capacity—with STRONG's exclusive Hi-Cap orifice;*
5. *No dribbling, quick, full opening—high ratio leverage.*

STRONG *in-line* 70 Series Traps are available in sizes from ½" to 1", semi-steel construction. STRONG's "two-in-one" blast trap with integral thermal air vent is also available in the 70 Series (see cut below).

Catalog No. 68 describes these traps in detail along with other STRONG traps. Write today.

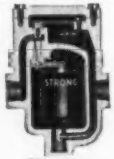
*Trademark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

ANUM METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve



Blast Trap

Strainer

STRONG

regulation, low ripple content, and low output impedance.

B supply is variable between 0 and 300 v delivering from 0 to 150 ma. C supply is variable between 0 and 150 v delivering 5 ma. In either case ripple is less than 5 mv. Ac output is 6.3 v, 5 amp, center-tapped, unregulated. Output voltage of both B and C supply varies less than 0.5% for line fluctuations between 105 and 125 v.

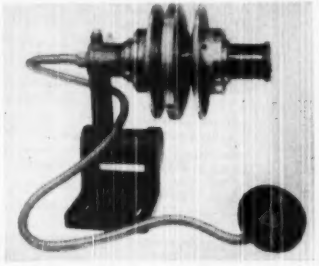
Kepco Laboratories, Inc, 149-14 41st St, Flushing, N.Y.

GAS CONDENSER P743

Five standard refrigerant-gas condensers, operating on the evaporative principle, range from 10 to 50 tons of refrigeration at 105-F Freon condensing temperature and 74-F atmospheric wet-bulb.

Casing, fan and eliminator are galvanized steel, condensing coils for Freon are copper with copper fin or hot galvanized-steel tube and fin.

Niagara Blower Co, 405 Lexington Ave, New York 17, N. Y.



VARIABLE-SPEED PULLEY P758

Stepless speed control is obtained with a double-groove single-belt pulley for speed ranges of 3 to 1 in plastic models with steel-faced sheaves. An aluminum-alloy model has a 3 to 1 speed range on drives of 1, 1½ and 2 hp.

Has positive sheave location to reduce ratio slip under varying or cyclic loads. Spacing between sheaves is set by mechanical control, which holds the spacing regardless of belt wear or belt stretch. Unit can be mounted in any position without causing serious belt wear.

Because pulleys are lightweight, there is no vibration at high speeds, and operation is smooth and quiet. Bearings are sealed for life; construction is rigid and compact. Speed-adjusting parts are lubricated at a single fitting. Either knob control, indicator dial or remote control is available.

American Type Founders, 200 Elmora Ave, Elizabeth, N.J.

TURBINE PUMP P751

Designed to meet the need for a pump where net positive suction head or space is limited. Its discharge casting with suction and discharge flanges, and multistage pump are enclosed in steel jacket. All drive types are available, including hollow- or solid-shaft motors, geared right-angle drive, V or flat-belt pulley and steam turbine.

Standard pumps are constructed with

Cost conscious engineers specify WICKES TYPE A steam generators

Three outstanding construction and design advantages make the Wickes Type-A Water Tube Boiler the most efficient of its type.

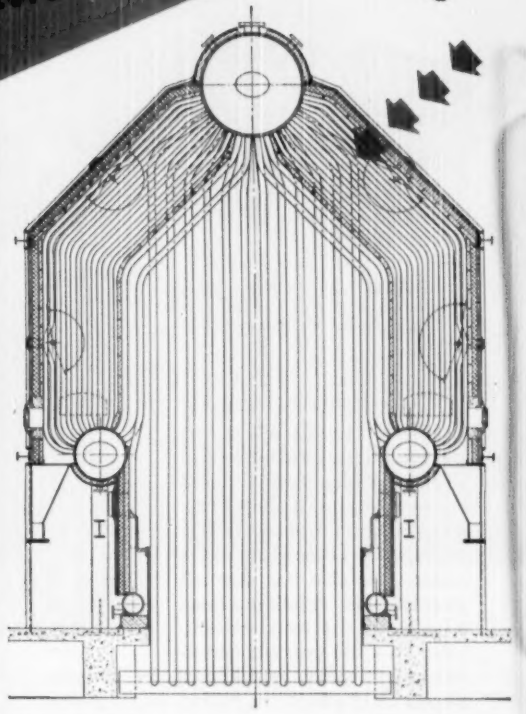
Wickes units have almost twice the black surface common to this class of boiler . . . this increases efficiency through greater heat absorption, permits carrying a higher CO_2.

Wickes steam generators draw the combustion gases through well-insulated passages across rows of staggered tubes . . . speeding optimum convection heat pickup, maintaining high operating efficiency.

Wickes Boilers assure fast, smooth water circulation through two simple U-tubes—higher absorption with no danger of clogging . . . proper baffling for unobstructed flow.

It will pay you to take advantage of Wickes' expert consultation before you buy a boiler. Wickes Steam Generators are sold and serviced the world over. Write today for complete catalog.

THE WICKES BOILER COMPANY • SAGINAW, MICHIGAN



Wickes Type-A Water Tube Boiler with 450 HP and 350 lbs. design pressure.

WICKES

SALES OFFICES: Atlanta • Boston • Buenos Aires • Chicago • Cincinnati • Detroit • Havana • Houston • Indianapolis • Los Angeles • Manila • Milwaukee • Mexico City • Montevideo • New York City • Pittsburgh • Saginaw • San Francisco • San Jose, Calif. • San Juan • Seattle • Springfield, Ill. • St. Louis • Tulsa.

189

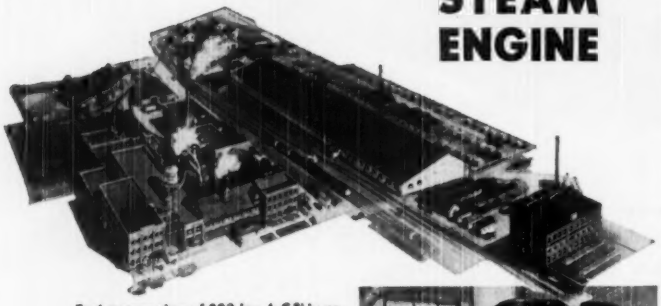
DIVISION OF THE WICKES CORPORATION • RECOGNIZED QUALITY SINCE 1854

MAKERS OF FAMOUS

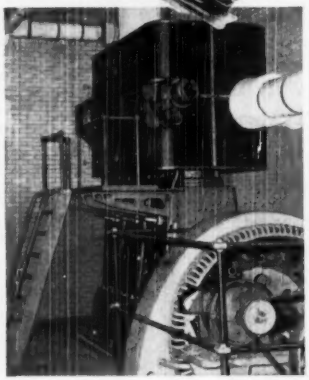
HOLGATE TOYS

GENERATE THEIR OWN POWER WITH A

SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINE



Engine room view of 800-kw, A-C Skinner Vertical "Universal Unaflow" Steam Engine at Holgate Brothers Company.



"Old as the Nation." In 1789, the year which saw George Washington take office as first President of the United States—Holgate Brothers Company, Kane, Pennsylvania, was established. Through its entire history, Holgate has devoted its production to and has been a leader in the woodworking field. This 161 year old manufacturer is today best known for Holgate Toys—famous among child educators, parents and children.

An 800-kw. Skinner vertical "Universal Unaflow" steam engine-generator unit has been recently installed in the Holgate plant to supply electric power, with exhaust steam being used for heating and processing. Still in daily operation are two Skinner steam engines, one installed more than 20 years ago. The installation of the new engine is testimony that "a repeat order is the best evidence of satisfaction."

Investigate the Skinner way of generating electric power, or of driving compressors, blowers, refrigeration and air conditioning equipment in your plant, hotel or institution. Catalogs and detailed information are available on request.

For Over 80 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

castiron bowls, bronze impellers and stainless-steel shaft. Special materials are supplied for abnormal conditions. Capacities range up to 5000 gpm and maximum head is 1500 ft. Applications include pumping gasoline, oil, hot or cold water, acids, mild or concentrated salt solutions at temperatures from normal to 400 F. Has a mechanical shaft seal to handle liquids under high pressure.

Peerless Pump Div, Food Machinery and Chemical Corp, Los Angeles 31, Calif.

ELECTRICAL SHUNTS P763

Switchboard-type for electrical instruments in three styles and 38 capacities from 10 to 20,000 amp. All lug blades are ¼ in. thick and spaced ¾ in. apart to receive ¼-in. busbar.

These shunts can be furnished already adjusted for 50, 75 or 100 mv drop. Multiple-range shunts are supplied in any range combination within the standard capacity.

Cole Instrument Co, 1320 South Grand Ave, Los Angeles 15, Calif.

ROOM CONDITIONER P773

Window-type, wood-grain-finish, ¾-ton. room air conditioner with instant-change filters and sealed-in compressor. Unit reaches only 11¾ in. into the room. It has an adjustable fresh-air intake and ventilation, with or without cooling.

Two controls on top of the cabinet make this adjustment possible. One adjusts fresh air. The second, a 3-position knob, controls (1) cooling and ventilating (2) ventilating only (3) both when off.

United States Air Conditioning Corp, 3302 Como Ave, S.E., Minneapolis, Minn.

POWER TOOL P774

New spring-impelled firing pin gives positive and easier action with no misfires or delays. Velocity-power driver fires a .32 or .44 caliber stud-cartridge that embeds studs in metal, concrete or masonry with a holding power of several thousand pounds. Tool is widely used for installing electrical equipment, pipe and duct hangers.

Mine Safety Appliance Co, Braddock, Thomas & Meade St, Pittsburgh 18, Pa.

WEATHERPROOF LOUVER P775

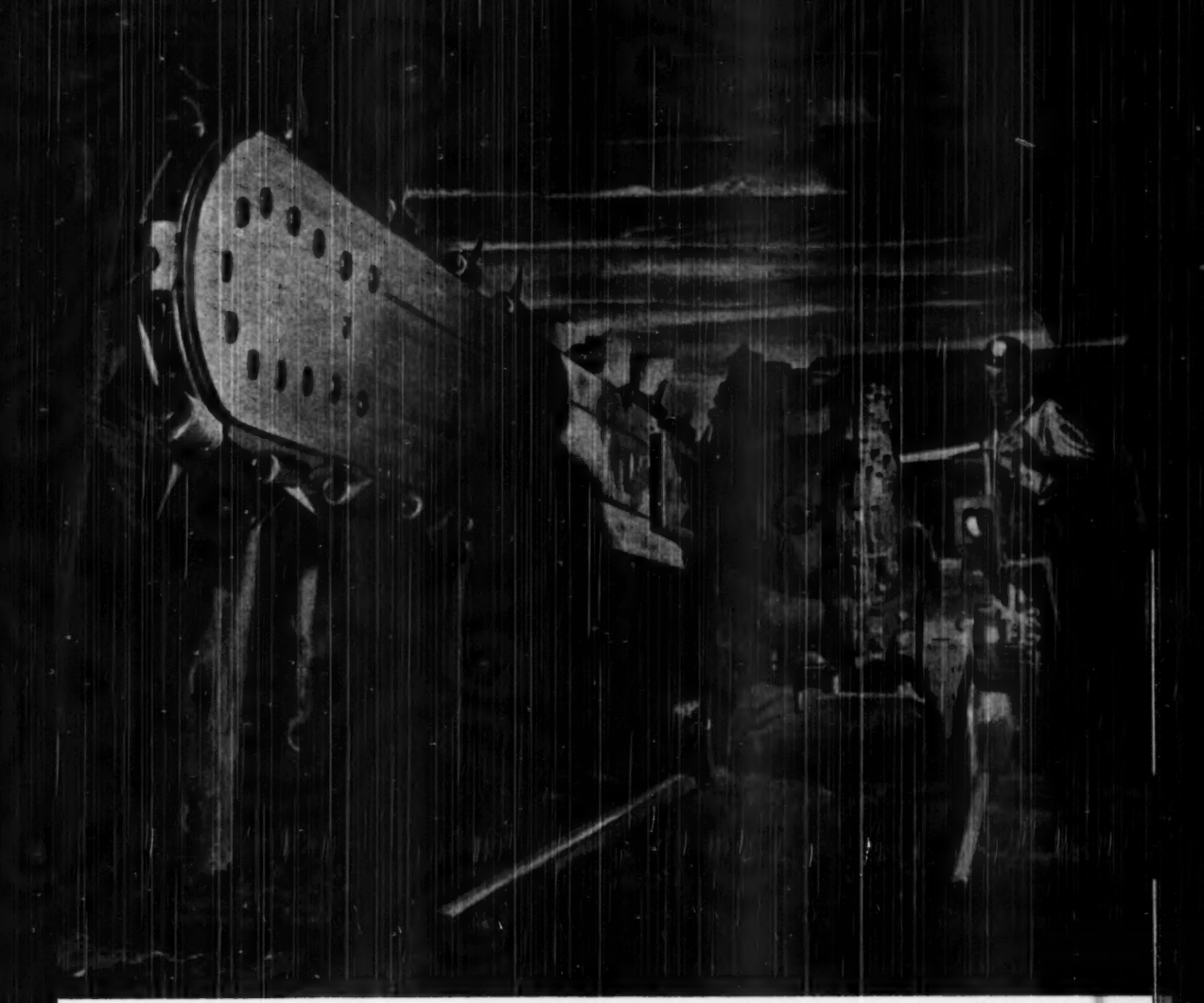
Heavy-duty frames and overlapping galvanized-steel blades, weatherproof in both open and closed positions, can be fitted for openings from as small as 11⅞ in. high by 12 in. wide to 74¾ in. by 48 in. By varying number of blades used and the frame-size, the *Airlouver* gives a pleasing pattern in adjustable or fixed designs.

Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio.

UNDERGROUND INSULATION P776

Cast-in-place *Z-Crete* gives a solid covering of water-repellent insulation that provides both insulation and the necessary structural conduit for underground steam lines.

Insulating concrete is made up of portland cement, vermiculite aggregate, special waterproofing admix and water, wrapped up in a waterproof envelope of three map-



BEACON COAL

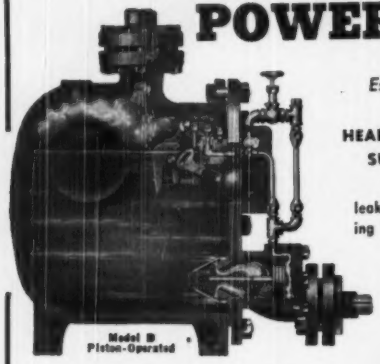
EASTERN GAS AND FUEL ASSOCIATES

PITTSBURGH · BOSTON · CHICAGO · CLEVELAND · DETROIT · NEW YORK
NORFOLK · PHILADELPHIA · SYRACUSE

For New England: New England Coal & Coke Co., For Export: Costney, Curran & Bullitt Inc.

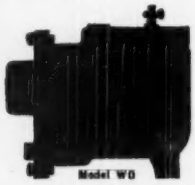
Nicholson Super-Trap for

POWER SERVICE



Especially Recommended for
STEAM PURIFIERS, HEADERS, SEPARATORS, HEATERS, SUPERHEATED STEAM LINES

leak even if cooked dry; rugged; working parts of stainless steel. Pressures, 2 to 650 lbs. The lowest price large capacity trap.



Thousands of installations attest to the enormous drainage capacity of this Nicholson trap. Piston-operated and with valve orifices up to 2" diam., it discharges large volumes of water almost instantly. Other features: won't

NICHOLSON WEIGHT - OPERATED TRAPS—Three models for press. to 200, 650 and 1500 lbs.; for steam, air, gasoline. Also feature large capacity and proof against leaking.

Catalog 250 or see Sweet's

W. H. NICHOLSON & CO.
125 Oregon St., Wilkes-Barre, Pa.

90% OPEN AREA
for light and ventilation

THE illustration shows the admission of light through three floors where the flooring is Hendrick Mitco.

Not only does pressure-formed Hendrick Mitco Open Steel Flooring have 90% open area, but there are no bolts, rivets or angle irons to collect dirt and refuse. The square-edge, uniformly spaced, rectangular steel bars provide a non-slipping, level walking surface.

Write for Catalogue of Hendrick Mitco Products

SEE OUR CATALOG IN SWEET'S

HENDRICK
Manufacturing Company

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Armorgrids

46 DUNDAFF STREET, CARBONDALE, PENNA.

Sales Offices In Principal Cities

pings of hot pitch and two layers of tar-saturated felts.
Zonolite Co, 12300 S. Ashland, Blue Island, Chicago, Ill.

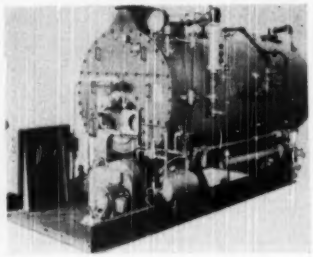
DIAL INDICATOR P777

Concentric or full-circle indicator for transmitting, receiving or controlling. Instruments have a large pointer with a 270-deg sweep, a black background with white numerals so the instrument can be read from 50 to 100 ft away.

Instrument may be used with only low-pressure unit or mercury manometer actuation for differential or absolute pressure applications. Standard ranges are 0 to 10 on the square-root scale; 0 to 100 and 0 to 200 on uniform scales.
Taylor Instrument Cos, 95 Ames St, Rochester 1, N. Y.

IMMERSION THERMOSTAT P740

Metal tube and rod of different coefficients of expansion, bonded to each other at one end with a switch operating off the other end, gives a frictionless immersion thermostat free of any strain. The *Rocket* fits into a 2-in. diameter housing, has a 1500-watt rating at 115-230 v, ac. It can operate in various ranges from –100 to 700 F.
George Ulanet Co, 417 Market St, Newark 5, N. J.



SELF-CONTAINED BOILER P715

New *LR*, addition to manufacturer's 600 to 20,000 lb-per-hr range of package steam boilers, is designed for more effective use of today's low-cost fuels, heavy oils and gas.

Model carries a rotary burner, compact and fully automatic, that is flexible in burning heavy oils and gas. A single, low-speed, low-power-consumption blower furnishes all combustion air.
Cleaver-Brooks, 326 East Keefe Ave, Milwaukee, Wis.

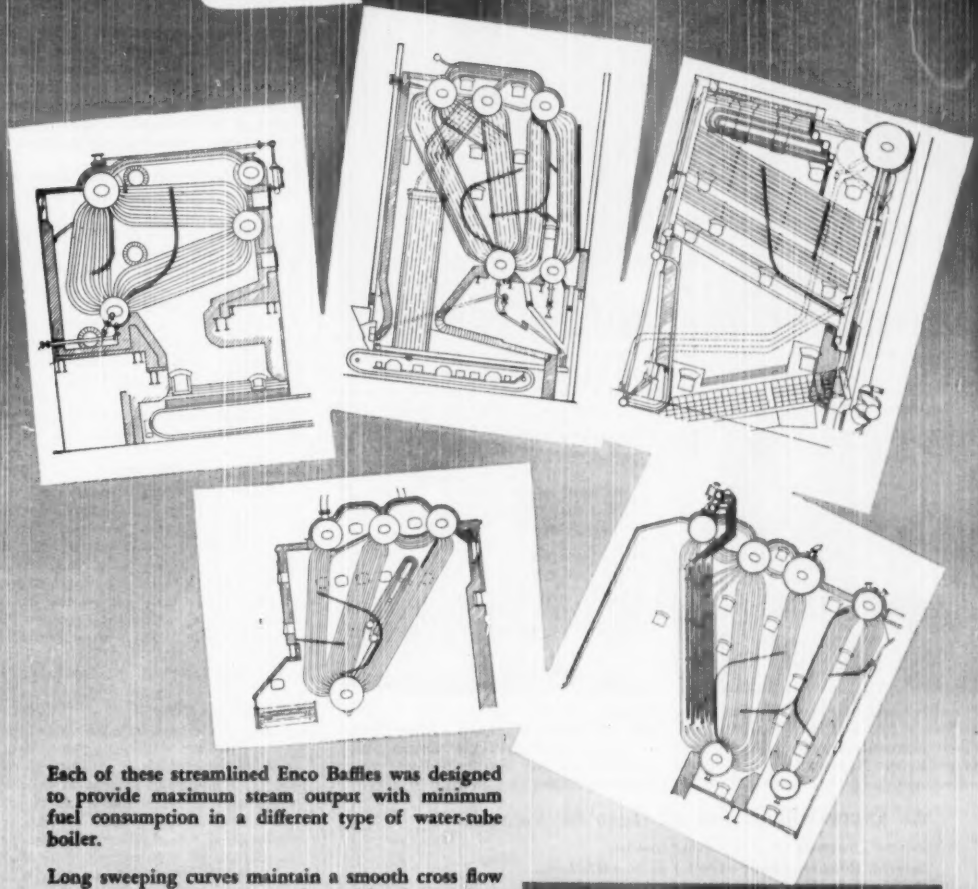
WATER TREATMENT P716

Colloidal, organic compound, *Agava*, prepared from vegetable juices is said to (1) prevent scale formation (2) dissolve old scale (3) protect surfaces from rust and corrosion (4) not contaminate the steam.
Agava Products Inc, 34 Exchange Place, Jersey City 2, N.J.

HUMIDITY INSTRUMENT P744

Two etched, scale glass thermometers mounted in a white plastic pocket-sized case make a small sling psychrometer. The

Streamlined for Savings
IN EVERY TYPE OF BOILER



Each of these streamlined Enco Baffles was designed to provide maximum steam output with minimum fuel consumption in a different type of water-tube boiler.

Long sweeping curves maintain a smooth cross flow of gases across every square foot of heating surface. Eddy currents, bottlenecks and dead gas pockets are eliminated—draft losses are cut to a minimum. Soot blowers work more effectively, less steam and less time are needed for cleaning.

Enco Streamline Baffles are individually designed and engineered to the exact requirements of your boiler. Experienced Enco-trained crews take charge of the installation.

The 18-page Enco Bulletin, BW44, shows how engineers throughout industry have gotten higher boiler efficiency and increased steam production through the use of Enco Streamline Baffles. Why not write for your **FREE** copy today?

The Engineer Company Produces:

ENCO OIL BURNERS

ENCO FUEL OIL PUMPING AND HEATING UNITS

ENCO AUTOMATIC OIL-ELECTRIC IGNITION SYSTEM

ENCO AUTOMATIC COMBUSTION CONTROL

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

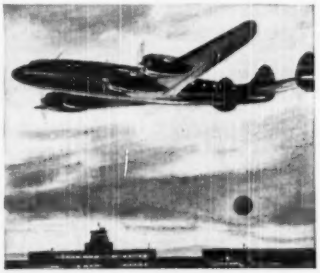
Canadian Representative:
F. J. Raskin, Ltd., 370 Rachel E., Montreal, P. Q.

BD-675

Atom pile by-products "fly" to help medical research

Radioisotopes were needed by a Boston hospital for patient treatment. Lead-shielded box of radioactive iodine (weight, 35 lbs.) picked up by Air Express in Knoxville, Tenn., at 11 A.M., delivered 7:15 P.M. Charge, $8.60. Hospitals, like all business, use Air Express regularly to get supplies from anywhere in hours.

It's easier and more convenient to use the *world's fastest* shipping service. When shipments are ready, just phone for pick-up. Special door-to-door service included in the low rates.



Shipments *keep moving.* Air Express goes on every Scheduled Airline flight. Frequent schedules. Use dependable, experienced Air Express—keep your business rolling at a profitable clip.

Air Express gives you all these advantages:

World's fastest transportation method.
Special door-to-door service at no extra cost.
One-carrier responsibility all the way.
1150 cities served direct by air; air-rail to 22,000 off-airline points.
Experienced Air Express has handled over 25 million shipments.

Because of these advantages, regular use of Air Express pays. It's your best air shipping buy. For fastest shipping action, phone Air Express Division, Railway Express Agency. (Many low commodity rates in effect. Investigate.)

AIR EXPRESS
GETS THERE FIRST

Rates include pick-up and delivery door to door in all principal towns and cities

A service of
Railway Express Agency and the
SCHEDULED AIRLINES of the U.S.

assembly, the TAG Humidicator, Model 8704, needs only to have a few drops of water added to the thermometer wick and to be swung in the air. Setting dry-bulb and wet-bulb readings opposite each other on the built-in slide rule gives relative humidity.
Weston Electrical Instrument Co, 614 Frelinghuysen Ave, Newark 5, N. J.

SPRAY GUN P772

Four-finger trigger-control spray gun, together with a patented nozzle, permits delivering a variable paint spray from the size of a silver dollar to a swath more than 12 in. wide. Spray is varied by a thumb-screw at the back of the gun. Separate lines deliver compressed air and paint to the gun.
Eclipse Air Brush Co, 390 Park Ave, Newark 7, N. J.

COOLING-WATER CONTROL P778

Insertion-type, pneumatic temperature control, small enough to go into a 2-in. water line, has a liquid-filled element that gives fast throttling control. Together with pneumatic valves, it saves water and improves efficiency in machines using water as a cooling medium. Such machines could be stationary gas or diesel engines.
Brown Instrument Div, Minneapolis-Honeywell Regulator Co, Wayne and Roberts Ave, Philadelphia 44, Pa.

MAGNETIC SWEEPER P779

Low-cost, lightweight rotary magnetic tube mounted between neoprene wheels works like a carpet sweeper. Ferrous material clings to the magnet over the entire circumference to a thickness of about ¾ in. A wiper ring pushed from one end to the other carries the ferrous material to a nonmagnetic section for unloading. Unit comes in sizes from 12 to 36 in.
Eriez Mfg Co, 7 E. 12 St, Erie, Pa.

EXPANSION JOINT P780

Flexoniflex expansion joints are built for 1000 psi for use wherever gases or fluids must be conveyed. Joint consists of corrugated, bellows-type sections of stainless steel or other alloys formed within integral control rings and end sections. Joints are manufactured with single or multiple plies and may be lined or unlined. Sizes begin from ⅝-in. ID and continue up through the range of extra high-pressure pipe. Temperature range is from subzero to 1400 F for stainless steel. Upper limit can be exceeded with special alloys.
Chicago Metal Hose Corp, Maywood, Ill.

AIR PURIFIER P737

Combined chemical and mechanical air filtering takes place in a 6-outlet air purifier that handles from 10 to 35 cfm of free air at a maximum pressure of 100 psi. Standard ¼-in. tap threads permit attachment of airline fittings.
E D Bullard Co, 275 Eighth St, San Francisco 3, Calif.

IRON AND STEEL COATING P752

To eliminate treating with chromic acid, apply this coating to iron and steel before

● DETROIT STOKERS
in Plants of Peter Cooper Corporations

Eastern Tanners Glue Division
Gowanda, N. Y.
1939—Five Detroit RotoStokers
1943—Two Detroit RotoStokers

Canada Glue Company, Ltd.
Brantford, Ontario
1939—Three Detroit RotoStokers
1946—One Detroit RotoStoker

Diamond Glue Division
Chicago, Illinois
1944—Two Detroit RotoStokers
1945—Two Detroit RotoStokers

United States Glue Division
Carrollville, Wisconsin
1946—Two Detroit RotoGrate Stokers
1947—Two Detroit RotoGrate Stokers

Peter Cooper Corporations—one of the oldest firms in America has bought Detroit Stokers in quantity since 1939.

Detroit Stokers have been highly satisfactory in meeting the demands for large outputs of precious steam with fluctuating loads. Their economy, ability to handle a wide range of bituminous coal without special preparation resulted in these repeat orders.

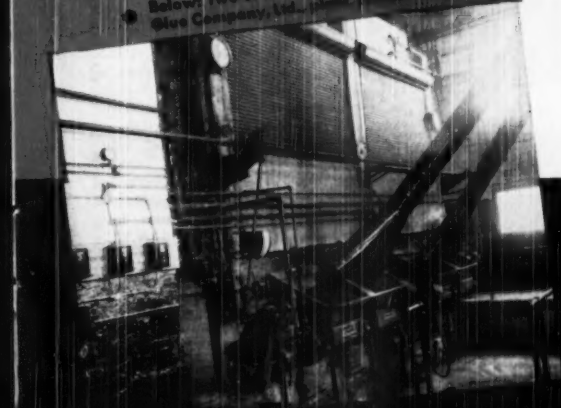
Detroit Stokers can provide economy in your plant. Write for information.

Peter Cooper* Corporations Served by DETROIT STOKERS

19 DETROIT STOKERS IN FOUR PLANTS SINCE 1939

● Detroit RotoGrate Stokers at United States Glue Division, Carrollville, Wisconsin.

● Above: Five of seven Detroit Stokers in Eastern Tanners Glue Division, Gowanda, New York.



● Below: Two of four RotoStokers at the Canada Glue Company, Ltd., plant in Brantford, Ontario.

* Peter Cooper (1791-1883) was one of the great pioneers of American Industry. Entering the glue and isinglass business early in the 19th Century, he ranged into many fields of endeavor. He built "Tom Thumb", the first locomotive built in America—was early in the iron and steel business—made the first rolled structural beams —was the first in U. S. to use the Bessemer steel making process. He also furnished much of the cash for laying the first Atlantic cable. Cooper is most famous for the Cooper Union, New York City, which he founded in 1859. Here, in 1860, Abraham Lincoln made the famous speech which opened his way to the presidency

DETROIT SINCE 1899 STOKERS

THERE IS A TYPE AND SIZE OF DETROIT STOKER FOR EVERY INDUSTRIAL OR POWER NEED

DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

District Offices in Principal Cities . . . Works at Monroe, Michigan

Winning a race against time

The doctor held his breath. An iron lung had stopped. For four years it had kept a little girl alive. Now . . . ? Feverishly, hospital attendants readied a temporary lung. But it would be only a matter of hours before substitute lung and young life would snuff out together.

Five hundred miles away in the Winsmith plant, the phone jangled with an urgent question. Could they? They'd *have* to! The clock on the wall said three. Experts cooly raced the hands of the clock and at four, the gravely needed speed reducer had been assembled and flown on its way.

That night, the little patient . . . *everyone* breathed easier. Winsmith had won a race against time.

Unusual? Not altogether, especially when an equipment manufacturer has the foresight to install a *standard* reducer. Yes, meeting and beating tough challenges is an old Winsmith habit, thanks to standardization and management's responsiveness to customers' problems.

Your speed reducer problems may not be a matter of life or death, but they're often a matter of profit or loss. Winsmith can help you solve these problems to your best interests . . . time-wise and cost-wise. One of the reasons . . . industry's widest range of standardized types and sizes up to 85 H.P. Another . . . the large inventory of standard parts ready for quick assembly. Together, they enable the Winsmith field engineer in your territory to prescribe to your needs right out of stock from one of these 3 basic types:

FREE CATALOG
Handbook No. 148 with complete engineering data. Write.

painting. It forms a dense, smooth film of low porosity and high plasticity, which cannot absorb paint excessively.
Kelite Products, Inc, PO Box 2917—Terminal Annex, Los Angeles 54, Calif.

WAFER VALVE **P724**

Torque-resistant, one-piece body, wafer valve. Vane, shaft assembly, hand-wheel control with self-locking worm and gear flareout on body casting is identical with double-flanged valve.
R-S Products Corp, Wayne Junction, Philadelphia 44, Pa.

INDICATING PYROMETER **P733**

Small, sturdy, dustproof, indicating pyrometer, Model 192, 7½ in. wide, 5 in. high, is available for flush and surface mounting. High-resistance movement, with alnico V magnet and wide-open mirrored scale, is fully compensated.
Wheelco Instruments Co, 847 W Harrison St, Chicago 7, Ill.

WETTING AGENT **P714**

On-the-line treatment of ordinary water or sea water, to increase its effectiveness in putting out fires, can be had with the *Pyrodyne* capsule.

Capsule is solid, weighs 3 lb, contains highly concentrated active blends of wetting elements selected for firefighting. Each capsule produces over 1000 gal of treated water.
Aquadyne Corp, 220 E 42nd St, New York 17, N.Y.

DIESELS: 90 to 200 HP **P771**

Five 4-cylinder models and six 6-cylinder models range in output from 90 to 200 hp. They feature plain open-combustion chamber, four valves per cylinder and hydraulic servo-type governor.
The Murphy Diesel Co, 5217 W. Burnham St, Milwaukee 14, Wis.

DC SERIES MILL MOTOR **P774**

C-W mill motor offers additional power without increase of frame size, greater resistance to overload, improved commutation, and reduced maintenance. This motor conforms to current AISE standards.

In a recent demonstration, tough operating conditions were simulated. No evidence could be detected of sparking while the motor was reversed at overloads running in the region of 300% normal current.
Elliott Co, Jeannette, Pa.

ALL-SERVICE HOSE **P756**

This hose is in line with the trend to save money and storeroom space in selecting equipment. With this type, a plant stores only one reel, cutting off lengths as required for air, water, gasoline, oil, mild-chemical or low-pressure spray requirements rather than have many lengths on hand, each serving a specialized purpose.
Hewitt-Rubber Div, Hewitt-Robins, Inc, 240 Kensington Ave, Buffalo 5, N.Y.

FLUORESCENT TESTER **P772**

Flur-Test is a pocket-size tester to locate trouble in fluorescent fixtures. It indicates

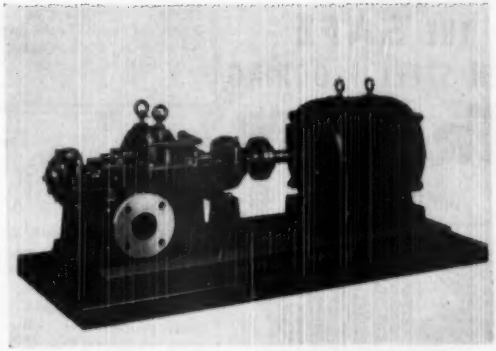
LIQUID CONTROL

SO NECESSARY TO EFFICIENT PLANT OPERATION

BE *Sure* OF IT— SPECIFY "Buffalo" PUMPS

Getting your liquids where you want them in the right volumes at all times—*liquid control*—must be backed up by DEPENDABLE PUMPS! "Buffalo" pumps have a reputation throughout industry for this kind of service. Extra heavy construction in every part—plus efficient design — are the reasons. DON'T LEAVE *YOUR* LIQUID CONTROL TO CHANCE.

Write for Bulletins 955-N and 980-B for helpful facts on any service you need.



"BUFFALO" CLASS "RR" PUMP FOR BOILER FEED SERVICE—in 20 to 900 gpm. capacities for heads up to 1500 ft.

"Buffalo" PUMPS

BUFFALO PUMPS INC.

488 BROADWAY BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.

Branch Offices in All Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

G-E LEAK DETECTORS

find leaks quickly

With G-E leak detectors you can easily locate even the smallest leaks in closed systems. Detectors are ideal for locating leaks in installed equipment or in the products you make.

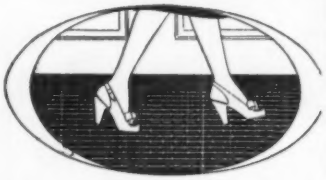
Use the Type H detector for pressure systems, the Type M for evacuated systems.* Write for Bulletin GEC-233 (Type H) or for GEC-336 (Type M). *Address Apparatus Dept., DD-687-21, General Electric Co., Schenectady 5, New York.*

**If the system is filled with combustible gas, write for special application information.*

GENERAL ELECTRIC

687-21

THE SAFE OPEN STEEL FLOORING IS TRI-LOK



No object over ½ square inch can pass through super-safe U-Type Tri-Lok Flooring. Fabricated without bolts, rivets or welds, it is unsurpassed for plant installation, walkways, loading platforms. Efficient distribution of concentrated loads . . . maximum free opening for light and air. Write for Bulletin JZ 1140.

DRAVO CORPORATION

National Distributor for the Tri-Lok Company

Dravo Bldg., Pittsburgh 22, Pa.

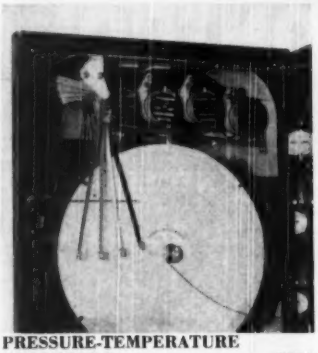
Sales Representatives in Principal Cities

DRAVO

whether the trouble is in the circuit, starter or tube.

Device fits into starter socket to make all three tests above. Two models are available, one for fixtures with 15 to 40 watt tubes and one for fixtures with 85 to 100 watt tubes.

Ideal Industries Inc, 1025 Park Ave, Sycamore, Ill.



PRESSURE-TEMPERATURE RECORDERS **P781**

Pressure and temperature recorders are self-actuated from gas-filled tube system; vapor-tension and liquid-filled types for temperature ranges from —100 to +800 F. Bourdon springs have been made unusually sturdy.

Case accommodates up to four pens, capable of recording any combination of temperature and pressure. Storage space allows stocking up to 200 charts and four bottles of ink.

Penn Industrial Instrument Corp, 3116 N. 17th St, Philadelphia 32, Pa.

New Steam Unit For San Diego

The San Diego Gas & Electric Co board of directors has approved the purchase of another 50,000-kw turbo-electric generator for its Silver Gate station in 1952, to cost about $8,000,000. At the same meeting, the board approved the 1950 construction program of $12,000,000.

Principal items in this year's construction program are $4,000,000 for completion of electric-generating unit No. 3 at Silver Gate; $1,622,000 for 15 substations, and $500,000 for rural transmission lines.

Bids for the first four generators of the Chief Joseph Dam powerhouse on the Columbia River in eastern Washington have been called for by the **Corps of Engineers.** These generators, the first of an eventual 27, will be 67,368 kva each. In addition, the Corps awarded S Morgan Smith Co, York, Pa., a $4,974,090 contract for design and manufacture of four 111,300-hp hydraulic turbines for the powerhouse at McNary Dam on the Columbia River.

FREE . . .

71 tips on low-cost maintenance-cleaning

HERE'S a 16-page digest that's packed with tested Oakite procedures for power-plant maintenance-cleaning—procedures that pay off in thorough cleaning, degreasing, descaling . . . reduced cleaning time . . . increased equipment efficiency. Shows how to save money in steam control systems, electric and diesel power plants.

Gives you step-by-step details and diagrams for 71 specific jobs, such as

- In-place cleaning of heat exchangers
- Stripping paint
- Cleaning oil, air filters
- Descaling condensers
- Removing rust
- Cleaning and descaling transformers

Condenses for you the successful experience of many plant superintendents who get low-cost maintenance through Oakite materials and methods.

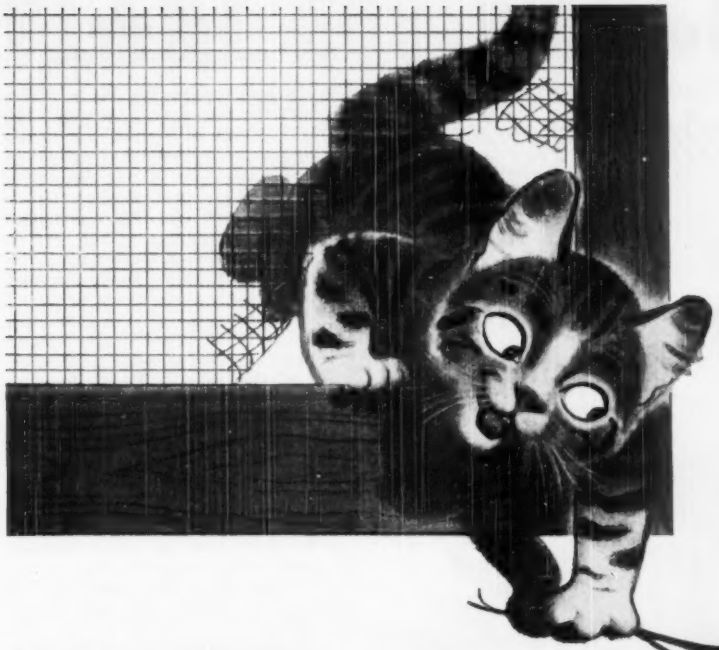
Get your FREE copy today. Write Oakite Products, Inc., 23 Thames St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING

OAKITE

MATERIALS • METHODS • SERVICE

Technical Service Representatives Located in Principal Cities of United States and Canada



*PENETRATION

Peak production . . . without worry of breakdown due to friction and wear . . . is made easier with Tycol high quality greases.

Made to "absorb punishment" without thinning down and dripping, Tycol greases avoid wasted lubricant, lost bearings and unnecessary down-time. These ultra-safe lubricants keep bearings . . . gears . . . shafts . . . friction-free and cool. They are available in grades with the proper "*PENETRATION" needed to give power a chance to produce with a minimum of waste.

Call your nearest Tide Water Associated office. Let them suggest the Tycol grease best suited to your needs . . . and remember, Tycol green cast greases are made from high quality cylinder stock and well refined neutral oil, with a minimum of soap — a maximum of oil . . . more efficient lubrication per pound of grease.

TYCOL

INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C. • Pittsburgh • Philadelphia • Chicago Detroit • Tulsa • Cleveland San Francisco • Toronto, Canada

TIDE WATER ASSOCIATED OIL COMPANY

17 BATTERY PLACE NEW YORK 4, N. Y.

*LEARN WHAT THIS PRODUCT CHARACTERISTIC MEANS TO YOU — READ "LUBRICANIA" This informative handbook, "Tide Water Associated Lubricania," gives clear, concise descriptions of the basic tests used to determine important properties of oils and greases. For your free copy, write to Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

REFINERS AND MARKETERS OF VEEDOL — THE WORLD'S MOST FAMOUS MOTOR OIL

THERE'S

No Reducing Problem

when you use

Masoneilan

Reducing Valves

Masoneilan Pressure Regulators —for steam, water or air service —reduce waste, cut costs and save money by holding pressures within the required limits without constant maintenance. That's why you find plant men in all types of industry using and recommending them for reducing service. Their experience proves that Masoneilan valves eliminate pressure reducing problems.

No. 11 for steam service — Sizes ½" to 4". Reduced pressure ranges between 5 and 75 psi or 75 and 225 psi. Maximum working pressure 250 psi.

No. 227 for water service—Sizes ¼" to 2". Reduced pressure range between 10 and 60 psi. Maximum working pressure 150 psi. Also available for air service from ¾" to 1".

Your local Mason-Neilan industrial distributor is ready to serve you from stock; or write

MASONEILAN

Mason-Neilan Regulator Company

1186 ADAMS STREET, BOSTON 24, MASS.

Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis Philadelphia • Houston • Denver • Pittsburgh • Cleveland • Cincinnati • Tulsa • Atlanta Detroit • Los Angeles • San Francisco • Salt Lake City • El Paso • Boise • Albuquerque Charlotte, N. C. Mason-Neilan Regulator Company, Ltd., Montreal and Toronto

Visit the Fifth National Instrument Exhibit at Memorial Auditorium in Buffalo, September 18-22, 1950. See our display in Booths Nos. 418, 420, and 422.

LOAD NEEDS

(*Continued from page* 105)

in torque must be about 120 to 150% to pull the mill into synchronism. This wide range in starting and pull-in torques results from line voltage swings, which may occur during the starting period. Then there may be variations in mill requirements. With a good power system and minimum voltage drop the lower motor torques would suffice.

Line-Shaft Drive. Smaller line-shaft drives use a squirrel-cage or wound-rotor motor. Larger drives, as in a flour-mill operation, would probably have a synchronous motor for pf correction. One curve in Fig. 5 shows unloaded start condition, with equipment warm, and the other, an unloaded start, with equipment cold. Mill may have been shut down over a weekend with the temperature near the freezing level.

Present-day practice is to direct-couple a synchronous motor to the mill line shaft. Hence this motor must have high starting and pull-in torques built into it, unless there is a clutch or fluid coupling to permit the motor starting light.

Another type of load has high inherent WK^2. It may be represented by a hammermill drive, a large rock crusher or mg set (with a flywheel) and certain types of fans, Fig. 6. Actual load-torque requirements of these types are usually quite low. Thing to remember is sufficient torque must be built into motor to accelerate the high WK^2 load within a reasonable time. Remember the kinetic energy stored in the flywheel must be obtained from the motor. And if starting period were prolonged, motor would overheat and fail.

National Assn of Power Engineers, New York Chapter No. 1, recently awarded the Grimshaw Medal to George J Humbert, building engineer of the Commodore displayed the most meritorious professional accomplishment.

Italian Ministry of Transport backed by Marshall Plan funds are going to tap two more power plants in the Tuscany subsurface steam fields, reports McGraw-Hill World News. First plants drawing steam from these underground pools of boiling water were in the Lardarello area nearly 75 years ago.

Nationwide survey of selected engineering personnel sponsored by the **Engineers Joint Council** for the U. S. Office of Naval Research has been advanced to July 15. Only two thirds of the 115,000 questionnaires sent out to those holding full professional grade of membership in 18 national societies have been returned.

PLANT EQUIPMENT NEWS

Reader Service Page for New Products and Literature

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

AIR CONDITIONING, HEATING, REFRIGERATION AND VENTILATION

A1 **GAS UNIT HEATERS** — 4-page folder No. 20-C-43 illustrates and describes Pittsburgh gas unit heaters, Series C, featuring cast-iron heat exchangers. Specifications for 6 sizes, ranging from 85 - 215,000 Btu per hr, are included. Automatic Gas Equip Co, 301 Brushton Ave, Pittsburgh 21, Pa.

A2 **UNIT CONDITIONERS, COILS** — 68-page catalog No. 425 covers complete line of Bush coils, air-handling and -conditioning units, evaporative condensers, and cooling towers for every commercial and industrial air-conditioning need. Bush Mfg Co, West Hartford 10, Conn.

A3 **INDUSTRIAL VENTILATION** — Guide provides a concise yet thoroughly informative coverage of general industrial ventilation problems and their economical solution. Propeller Fan Mfrs Assn, 2159 Guardian Bldg, Detroit 26, Mich.

BOILERS AND AUXILIARIES

B1 **ECONOMIZERS** — 8-page booklet No. 169 describes the Premier Diamond line of economizers. Both cast-iron tube (Type 25) and steel tube (Type 12) economizers are covered in detail. Green Fuel Economizer Co, Inc, Beacon, N. Y.

B2 **FIREBRICK** — Bulletin features Warco brand intermediate-duty and high-heat-duty firebrick. Properties are detailed and general characteristics and uses are specified. Walsh Refractories Corp, Dept W, 101 Ferry St, St. Louis 7, Mo.

B3 **DUST COLLECTORS** — 4-page folder discusses advantages of Bubar dust collectors for boilers fired with coal, lignite, bark, wood or bagasse. Operation data and illustration are given of the type "S" collector. Bubar Dust Systems Inc, Old Lyme, Conn.

CONTROLS, ELECTRIC

D1 **HYDRAULIC REMOTE CONTROLS** — 8-page booklet No. 30-105 describes 2 series of hydraulic remote controls and available accessories, including intermediate transmitter for use at secondary-control stations. Industrial Sales Section, Sperry Products Inc, Danbury, Conn.

D2 **LEVEL CONTROL** — 4-page leaflet gives principle of operation and special applications of the Belmont level control. Illustrations are included. Thermo Instruments Co, Belmont, Calif.

ELECTRICAL EQUIPMENT

F1 **DC GENERATORS** — 4-page publication No. B41-300 contains informative data and illustrations of the company's expanded line of dc generators for lighting and power supplies. Electric Products Co, 1725 Clarkstone Rd, Cleveland 12, Ohio.

F2 **SERVO-MECHANISM PARTS** — 12-page bulletin entitled "Arma Synchro Units," describes 6 new miniature servo-mechanisms, which are included in 2 groups of electromagnetic units for transmitting electrically a continuous, accurate indication of angular position. Arma Corp, 254 36th St, Brooklyn 32, N. Y.

HOW TO ORDER ADDITIONAL DATA

Be sure to fill out, completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each item of information you want, detach along the scored lines and drop the cards in the mail.

Example

Write here number of item in which you are interested → E17

Your Company Name: Brown Mfg.Co.

Address: 3718 First Avenue, Pottsville, Okla.

Your Name: John Smith

Your Title: Power Engineer

POWER, 330 West 42nd St., New York 18, N. Y.

FILL OUT AND MAIL TODAY! NOT GOOD AFTER OCT 1, 1950

Write here number of item in which you are interested →

Your Company Name.....

Address.....

.....

Your Name.....

Your Title.....

POWER, 330 West 42nd St., New York 18, N. Y. 7/50

Write here number of item in which you are interested →

Your Company Name.....

Address.....

.....

Your Name.....

Your Title.....

POWER, 330 West 42nd St., New York 18, N. Y. 7/50

Write here number of item in which you are interested →

Your Company Name.....

Address.....

.....

Your Name.....

Your Title.....

POWER, 330 West 42nd St., New York 18, N. Y. 7/50

Write here number of item in which you are interested →

Your Company Name.....

Address.....

.....

Your Name.....

Your Title.....

POWER, 330 West 42nd St., New York 18, N. Y. 7/50

Write here number of item in which you are interested →

Your Company Name.....

Address.....

.....

Your Name.....

Your Title.....

POWER, 330 West 42nd St., New York 18, N. Y. 7/50

Write here number of item in which you are interested →

Your Company Name.....

Address.....

.....

Your Name.....

Your Title.....

POWER, 330 West 42nd St., New York 18, N. Y. 7/50

Write here number of item in which you are interested →

Your Company Name.....

Address.....

.....

Your Name.....

Your Title.....

POWER, 330 West 42nd St., New York 18, N. Y. 7/50

F3 **LIGHTING EQUIPMENT**—Booklet, entitled "Your Lighting Simplified," contains helpful information for proper selection and purchase of lighting equipment. Edwin F Guth Co, 2615 Washington Ave, St Louis 3, Mo.

F4 **STOCK LIST** — 16-page current catalog 1622 lists rebuilt motors, generators, mg sets, automatic starters, gear reducers, magnetic starters, pumps, transformers, etc. Electric Generator & Motor Co, 4519 Hamilton Ave, Cleveland 14, Ohio.

MAINTENANCE MATERIALS

L1 **AIR HOSE**—4-page leaflet No. 139 explains the design, construction and rubber-compounds of Conservo, a general-service air hose with a rayon cord carcass. Hewitt Rubber Div, Hewitt-Robins Inc, 240 Kensington Ave, Buffalo 5, N. Y.

L2 **LUBRICATION METHODS** — Booklet, entitled "11 Ways to Cut Production Costs," presents examples of production or machinery expense economies, attained through modern handling and application of greases and oils. Alemite Div, Stewart-Warner Corp, 1826 Diversey Pkwy, Chicago 14, Ill.

L3 **REFRACTORIES**—6-page circular No. 128A gives application information and reference data on the complete line of Laclede-Christy refractory products, including cements and mortars, plastics, castables, coatings and firebrick. Laclede-Christy Co, 3600 Forbes St, Pittsburgh 13, Pa.

L4 **FLOOR RESURFACER** — 4-page folder, entitled "No Floor Chopping," illustrates and describes applications of Stonhard resurfacer for producing smooth heavy-duty floors. Stonhard Co, Dept P, 1306 Spring Garden St, Philadelpthia 23, Pa.

L5 **ALL-SERVICE HOSE** — Bulletin No. 137 features Hewitt's Servall hose for intermittent, light-duty service in handling air, water, moderate amounts of gasoline, oil, mild chemicals and other fluids. Hewitt Rubber Div, Hewitt-Robins Inc, 240 Kensington Ave, Buffalo 5, N. Y.

L6 **REFRACTORY CEMENT**—Single-sheet form No. R-48 discusses R & I Moldit Chrome, a chrome-base castable high-temperature refractory, which can be poured easily into any shape or form. Refractory & Insulation Corp, 120 Wall St, New York 5, N. Y.

L7 **CONCRETE CONSTRUCTION** — 12-page booklet, entitled "15 Steps to Better Concrete Construction," lists detailed information and specifications on Sika compounds engineered to answer specific problems of concrete and masonry construction. Sika Chemical Corp, 37-41 Gregory Ave, Passaic, N. J.

MATERIALS HANDLING

M1 **BELT CONVEYORS** — 40-page catalog presents the Redi-Fab series of permanent belt conveyors. Contents include typical applications, layout instructions, package breakdowns and specifications, accessories, and selection tables. Barber-Greene Co, Aurora, Ill.

M2 **CAR UNLOADER**—4-page folder No. 2-50-KCU illustrates how the Kinney car unloader removes frozen coal out of hopper cars without the use of heat. Heyl & Patterson Inc, 55 Water St, Pittsburgh 22, Pa.

M3 **HOISTWAY DOORS** — 12-page booklet No. A-389 contains installation data and construction features of Otis freight elevator hoistway doors and vertical-lifting car grates. Otis Elevator Co, 260 11th Ave, New York 1, N. Y.

M4 **HEAVY-DUTY SHAKEOUT** — 4-page bulletin No. 2338 describes the new line of Link-Belt heavy-duty "CA" foundry shakeouts available in standardized sizes ranging from 8-30,000 lb load capacity. Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

MECHANICAL TRANSMISSION

N1 **AUTOMATIC CLUTCHES** — Complete line of Mercury automatic clutches is set forth in 3 bulletins: No. 216, 8 pages, gives a general description, listing and illustrating various applications; No. 217, 4 pages, deals with Mercury automatic clutches applied to gasoline engines; No. 218, 4 pages, covers electric motor installations. Automatic Steel Products Inc, Mercury Clutch Div, Canton 6, Ohio.

N2 **SPEED REDUCER**—4-page folder No. HW-150 features the new Winsmith Type DBRA speed reducer, fully standardized and stocked in 24 assemblies. Diagrams and torque output ratings table are included. Winfield H Smith Corp, Springville, Erie County, N. Y.

METERS AND INSTRUMENTS, MECHANICAL

T1 **CONTROL LINKAGE** — 16-page brochure No. CA942 presents control connecting linkage for use with Bailey control drives. Also contains engineering and price data for choosing and ordering the correct material and arrangement to suit almost any application. Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio.

T2 **GAS ANALYZER**—4-page leaflet No. 120 describes an improved type of gas analyzer for measuring CO_2, O_2 and CO. Complete details and illustrations are given. Ellison Draft Gage Co, Inc, 214 W Kinzie St, Chicago 10, Ill.

T3 **RECORDING GAS THERMOMMETERS** — 6-page bulletin No. T843 tells about the Series 500 pipeline recording thermometers for natural and manufactured gas temperatures. Photographs and drawings showing methods of application are included. Bristol Co, Waterbury 20, Conn.

T4 **PNEUMATIC METERING ELEMENT**—4-page folder No. 2150 describes and illustrates the Hagan meter type differential Master Sender, a pneumatic machine used as the metering element in measurement and control of steam, gas and liquid flow, liquid level, pressure differential and similar applications. Hagan Corp, 323 Fourth Ave, Pittsburgh, Pa.

T5 **STEAM CALORIMETER**—4-page leaflet No. 118 covers the Ellison U-Path steam calorimeter, which combines a throttling, separating and re-evaporating calorimeter in a single chamber. Ellison Draft Gage Co, Inc, 214 W. Kinzie St, Chicago 10, Ill.

(Continued on page 194)

FIRST CLASS
PERMIT No. 64
(Sec. 34.9, P.L. & R.)
NEW YORK, N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

4c. Postage Will Be Paid by—

POWER

330 West 42nd Street

New York 18, N. Y.

FIRST CLASS
PERMIT No. 64
(Sec. 34.9, P.L. & R.)
NEW YORK, N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

4c. Postage Will Be Paid by—

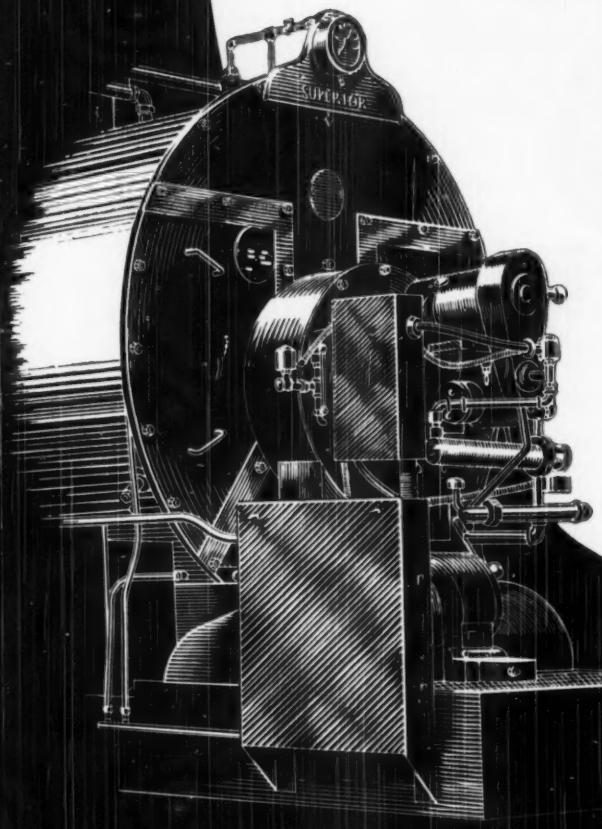
POWER

330 West 42nd Street

New York 18, N. Y.

For STEAM DIVIDENDS Tomorrow

Buy SUPERIOR STEAM GENERATORS Today



The operating economies which result from Superior's higher efficiency and long-lived dependability pay *real* dividends to their owners. Their thermal efficiency (guaranteed to exceed 80%) insures lowest fuel costs. Their rugged, heavy-duty construction spells years of dependable, trouble-free operation.

Fuel and maintenance savings are outstanding where Superior Steam Generators have replaced older equipment . . . but the greatest dividends result where Superior Steam Generators are specified for new steam plants. For here are added to their economy of operation (1) the economy of small space, (2) the elimination of an expensive stack (for Superior's induced draft requires only a vent for the products of combustion), and (3) simplified installation resulting from Superior's complete factory assembly and wiring.

There'll never be a better time to buy a Superior Steam Generator . . . because these dividends start with the first day's operation, and every day thereafter adds its dividend.

17 sizes from 20 to 500 b.h.p. for pressures up to 250 p.s.i. Fully automatic with all grades of oil or gas. For complete data write for Catalog 201.

uperior ombustion ndustries, inc.

Factory Emmaus, Pa.
Executive Offices Times Tower, Times Square, New York 18, N. Y.

9-R-16

Wherever pipes meet, permanently

IN POWER PLANTS,
the right answer to every temperature and pressure Fittings Problem is W-S Screw End and Socket Weld Forged Steel Fittings.

Basic materials are selected from a wide choice of chrome-moly, carbon and alloy steels. Designs are carefully engineered. Fittings are drop forged for strength . . . precision machined for accuracy of finish, and instrument inspected for perfection of threads, sockets, angles and concentricity. Investigate them today.

Write for Bulletin A3-50. For information on Stainless and Alloy Steel Fittings, ask for Bulletin S-1.

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE

SPECIFY...
W-S
FORGED STEEL FITTINGS

DISTRIBUTORS PRODUCTS DIVISION, ROSELLE, NEW JERSEY
WATSON-STILLMAN Established 1848
Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

PIPING, FITTINGS, VALVES AND SPECIALTIES

U1 **REDUCING AND REGULATING VALVES**—8-page booklet No. 283 consists of changes, additions and improvements in a particular line of pressure reducing and regulating valves, which are suitable for domestic and many industrial uses. Also features a new automatic reseating relief valve. A W Cash Valve Mfg Corp, 666 E Wabash Ave, Decatur, Ill.

U2 **STEAM TRAPS**—32-page catalog No. 250 describes thermostatic steam traps; weight-operated traps for steam, air, gasoline; expansion steam traps; piston-operated steam traps; also 3 types of steam, air and gas separators. Capacity tables, installation diagrams, etc, are given. W H Nicholson & Co, 12 Oregon St, Wilkes-Barre, Pa.

U3 **DUPLEX TUBING**—12-page technical bulletin No. 1950 discusses duplex tubing developed for conditions where single-walled tubing cannot withstand simultaneous attack from two entirely different types of corrosive media. Installation methods are explained and illustrated in detail. Bridgeport Brass Co, 30 Grand St, Bridgeport 2, Conn.

U4 **AIR ELIMINATOR**—Form No. 119 gives specifications on the No. 12 Gorton high-pressure air eliminator used under steam pressure up to 150 lb. Gorton Heating Corp, Cranford, N. J.

U5 **BONNET VALVES** — 12-page booklet entitled "Crane Pressure-Seal Bonnet Valves," contains sizes, dimensions, ratings and tests for gate, globe angle and stop-check valves for high-pressure and high-temperature service. Crane Co, 836 S Michigan Ave, Chicago 5, Ill.

U6 **PIPE FITTINGS** — Catalog No. 50F lists cast-iron and malleable pipe fittings for every pipeline use. Each listed size has price, weight and dimensions in addition to a photograph and dimension drawing of each fitting. Stockham Valves & Fittings, Box 2592, Birmingham 2, Ala.

U7 **SAMPLING VALVES** — 4-page folder No. 4 features Aloyco sampling valves; 3 standard types are illustrated in cross-sectional views. Working pressures and dimensions are also given. Alloy Steel Products Co, 1300 W Elizabeth St, Linden, N. J.

U8 **CONDUIT FITTINGS** — 4-page bulletin No. 201 covers the company's line of conduit elbows, couplings, nipples, goosenecks, running thread pipe and running thread nipples. List prices and sizes are included. Conduit Nipple Mfg Co, 1455 Spring Garden Ave, Pittsburgh 12, Pa.

PUMPS

W1 **CENTRIFUGAL PUMPS**—4-page folder No. W-318-B21 illustrates and outlines features of Worthington 2-stage, double-suction, centrifugal pumps. Dimensions are given. Worthington Pump & Machy Corp, Harrison, N. J.

W2 **AIR-POWERED PUMPS**—16-page booklet No. 450 furnishes design details, advantages and applications of "airROYmetric and airROY" air-cylinder powered chemical pumps, automatic chemical feed systems, and automatic hydrostatic test pressure systems. Milton Roy Co, 1300 E Mermaid Lane, Chestnut Hill, Philadelphia 18, Pa.

W3 **ROTARY PUMPS** — 6-page bulletin No. 307 illustrates design, construction, maintenance, operation and application of rotary pumps. Blackmer Pump Co, 1904 Century S W, Grand Rapids 9, Mich.

W4 **CENTRIFUGAL PUMP** — 4-page folder No. 7212 discusses the Class CRVR cradle-mounted centrifugal pump for process and refinery service. Specifications are listed. Ingersoll-Rand, 11 Broadway, New York 4, N. Y.

W5 **VACUUM PUMPS**—12-page catalog No. 50-B-13 covers the cycloidal vacuum pumps, a positive dis-

PUT YOUR FUELS TO WORK WITH PEAK EFFECTIVENESS

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

As operating expense hits high figures, new savings must be unearthed to combat these excessive costs.

We call your attention to your boiler room. Here is a number ONE place to make cost cuts through gaining peak effectiveness of your fuels.

The way to accomplish this most desirable result is through the installation of a CASH STANDARD Automatic Combustion Control System.

When you do that you realize—LESS FUEL COSTS—LARGER BOILER CAPACITY—SAVINGS IN MAINTENANCE.

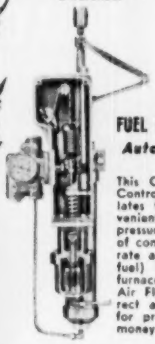
The reason for these three benefits is that these CASH STANDARD units give you CORRECT FUEL FEED—FUEL-AIR RATIO, and OVER-FIRE DRAFT.

Whether you burn coal, oil, or gas these CASH STANDARD UNITS present an immediate opportunity for you to save money and have a highly modern boiler room.

SEND FOR
Bulletin 300
It shows applications—tells how the system works effectively and continuously for a dependable cost saving job.

SYSTEMS FOR ONE OR A BATTERY OF BOILERS

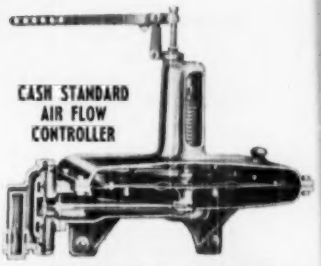
● **CASH STANDARD** units are available in a number of variations. Combinations can be made to give you complete automatic control with all of its benefits. Size of your boiler or type makes no difference.



CASH STANDARD FUEL FEED CONTROLLER . . .

Automatically Regulates Fuel Feed

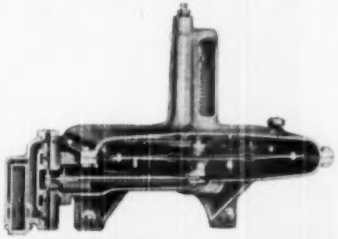
This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.



CASH STANDARD AIR FLOW CONTROLLER

Meters the Air Needed for Combustion

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



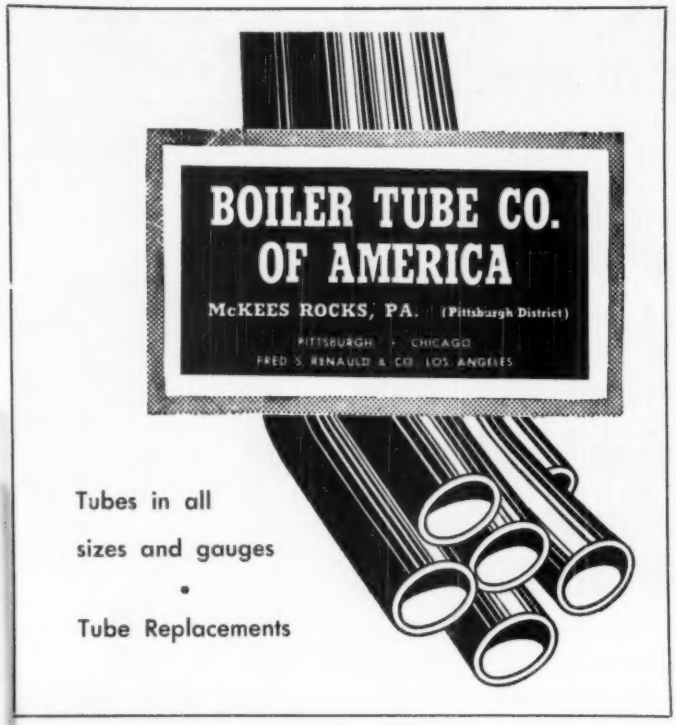
CASH STANDARD FURNACE DRAFT CONTROLLER

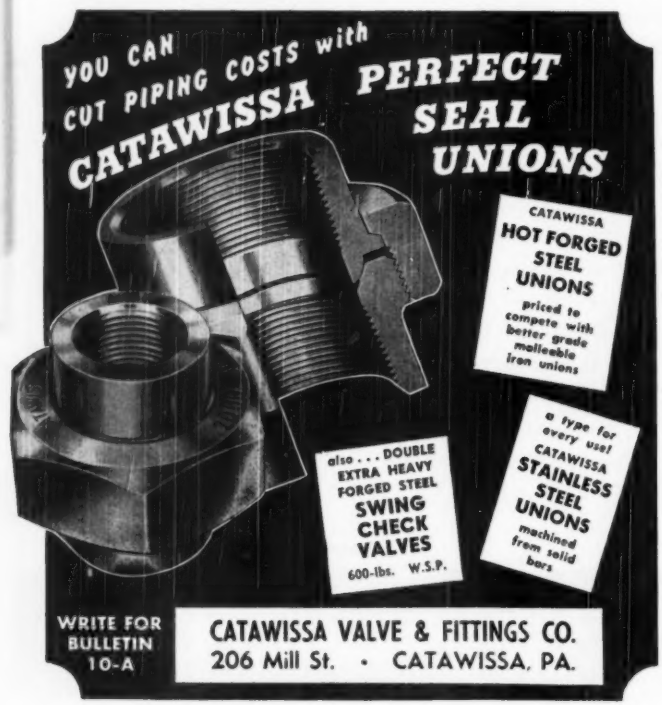
Maintains a Constant Draft in the Combustion Chamber

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES




YOU CAN
CUT PIPING COSTS with
CATAWISSA PERFECT SEAL UNIONS
CATAWISSA
HOT FORGED STEEL UNIONS
priced to compete with better grade malleable iron unions
also . . . DOUBLE EXTRA HEAVY FORGED STEEL SWING CHECK VALVES
600-lbs. W.S.P.
a type for every use!
CATAWISSA
STAINLESS STEEL UNIONS
machined from solid bars
WRITE FOR BULLETIN 10-A
CATAWISSA VALVE & FITTINGS CO.
206 Mill St. • CATAWISSA, PA.

placement pump designed for heavy-duty suction service, such as required in paper mills. Roots-Connersville Blower Corp, 900 W Mount St, Connersville, Ind.

W6 **CENTRIFUGAL PUMP** — 4-page leaflet No. B-592 describes the Peerless Hydro-Line encased close-coupled vertical centrifugal pump. Diagram is included. Peerless Pump Div, Food Machy & Chem cal Corp, 301 W Ave 26, Los Angeles 31, Calif.

WATER TREATMENT

X1 **CHLORINE TREATMENT** — 4-page Bulletin No. A-1A-4 summarizes present-day processes and equipment for the chlorine treatment of municipal water. Flow diagrams and illustrations describe use and advantages of process instrumentation in municipal water treatment. Fischer & Porter Co, 1000 County Line Rd, Hatboro, Pa.

WELDING

Y1 **WELDING FITTINGS** — Catalog No. 48 contains charts, tables, graphs, condensations and discussion of pipe specifications, welding data, design formulas, metallurgical information and other engineering data. Midwest Piping & Supply Co, Inc, Second & Miller St, St. Louis 4, Mo.

Y2 **RESISTANCE WELDING**—4-page brochure No. RW-2 offers information regarding Ampco's line of resistance-welding tips, wheels, water-cooled holders, welding dies, welder shafts, bushings and quick-disconnect water-shutoff couplings. Ampco Metal Inc, 1745 S 38th St, Milwaukee 15, Wis.

OTHER EQUIPMENT

Z1 **COMPRESSED-AIR POWER**—18-page booklet contains extensive basic reference data on compressed air and gas power. Booklet is divided into 3 sections: Uses of Compressed Air; Theory of Compressed Air; Types of Compressors. It is written in non technical language. Secretary, Committee on Engrg Education, Compressed Air & Gas Institute, 1410 Terminal Tower, Cleveland 13, Ohio.

Z2 **SURFACE CONDENSERS** — Bulletin No. W-200-B1 discusses Worthington surface condenser design, methods of installing condenser tubes and construction on various types and sizes. Auxiliary equipment is also covered. Photographs, and drawings are given. Worthington Pump & Machy Corp, Harrison, N. J.

Z3 **INSULATION TESTER**—24-page catalog No. 21-20 describes the heavy-duty type of Megger insulation and resistance testers. Several types are shown as well as other Megger instruments. James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

Z4 **DIESELS AND ACCESSORIES**—8-page booklet No. 12829 cites instances where diesel engines and electric sets used as standby power have come to the rescue of medical institutions isolated by storms and power failures. Caterpillar Tractor Co, Peoria 8, Ill.

Z5 **CORROSION PROPERTIES** — 24-page technical bulletin T-6 describes the resistance of nickel and its alloys to corrosion by caustic alkalies. Methods of testing as well as results are given. International Nickel Co, Inc, 67 Wall Street, New York 5, N. Y.

E F Drew & Co, Inc has found their four lecture and discussion meetings on fundamentals of water chemistry so popular, they have been scheduled for additional cities. R C Ulmer, technical director, Power Chemicals Div, conducts the course.

Introducing THE ELGIN MonoFlo DEIONIZER

The long-sought, single-tank deionizer is now a reality!

One of the truly dramatic developments in the field of water conditioning is deionization, that remarkable process for removing unwanted minerals from water. For nearly all purposes, deionizing actually produces water freer from impurities than *distilled* water — and *at a fraction of its cost!*

But remarkable though this economy has been, the cost of deionization has now been further reduced by another big development. It is the Elgin MonoFlo DeIonizer illustrated below. As simple in form as a zeolite softener, it replaces the two and four-column deionizers formerly used. Naturally, it is far more economical to buy and operate; yet in many respects it is a big improvement over even the most elaborate systems.

What does it accomplish?

Compared with multi-tank methods, the Elgin single-tank method offers: (1) a simpler way to produce a far higher quality water, (2) a reduction of regeneration-time and rinse-water, (3) a lower first cost and operating cost, (4) far less space required, (5) production of high quality water immediately after shut downs, (6) elimination of leakage of ions prior to exhaustion and prevention of leakage of amines, color bodies and the like, which occurs in other methods.

The Elgin single-tank deionizer is made in two types to cover two broad fields — the MonoFlo DeIonizer for applications where standard deionized water is required; the Ultra-DeIonizer for use where water of extremely high quality is needed. Both types have the Elgin "Double Check" design particularly important in units of this type as explained below. MonoFlo units remove ionized mineral matter, but only a small portion of the CO_2 and silica; whereas the Ultra-DeIonizer units completely remove these impurities. The MonoFlo units are lower in cost and therefore desirable where CO_2 and silica are not of primary concern.

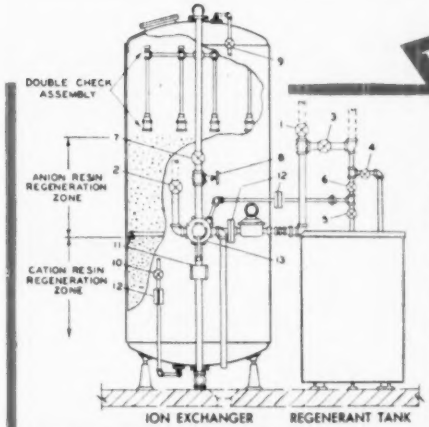
What is the quality of the water produced?

The best way to test the degree to which mineral impurities have been removed from water is to test its electrical resistance. For example, good quality distilled water has about 50 thousand ohms specific resistance . . . but . . .

Incredible though it may seem, the specific resistance of Ultra-DeIonized water is above 5 million ohms — a hundred times greater than that of most distilled water. In fact, with careful control, water having resistance over 23 million ohms has been produced. Think what that means!

Where can this unit be used?

In the past, deionizing has been used for boiler feed in high pressure plants or for processes requiring extremely pure water. However, in this simplified and more economical form, the scope of the deionizer is broadened to include lower pressure plants and many other processes where high quality water is desirable. Our engineering department will be glad to show you how it fits into your conditions. Write today.



1 HARD WATER INLET VALVE
2 DEIONIZED WATER OUTLET VALVE
3 SOFT WATER INLET VALVE
4 REGENERANT MAKEUP VALVE
5 REGENERANT SUCTION VALVE
6 REGENERANT RINSE VALVE
7 UPPER MANIFOLD VALVE
8 MID-MANIFOLD VALVE
9 AIR VENT VALVE
10 AIR INLET VALVE
11 EFFLUENT QUALITY CONTROLLER
12 RATE OF FLOW INDICATORS
13 MULTIPORT VALVE

ELGIN SOFTENER CORPORATION
130 North Grove Avenue, Elgin, Illinois

ELGIN ECONOMICAL WATER CONDITIONING SINCE 1908

HOW IT WORKS —

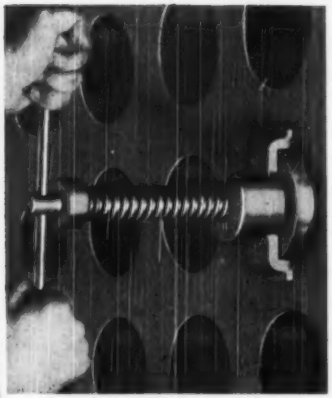
Deionization of water calls for the use of two resinous exchangers; one for the positively charged ions (the cations) and one for the negatively charged ions (the anions). One exchanger is regenerated by an acid solution; the other by a caustic solution, so this has formerly required two exchanger tanks along with other complications.

In the Elgin MonoFlo DeIonizer, the two exchangers are intermixed in a single tank during the service period. But the two exchangers used have a marked difference in density which permits them to be divided by simple backwash into two zones for separate regeneration as diagrammed. Each regenerant solution is introduced into its proper zone. Thus, in this simple unit, the engineer's dream has become a reality — water is deionized, the resin mixture separated into its components, the two resins regenerated, remixed, and again returned to the deionizing cycle. Simple manipulation of the Elgin Multiport Valve and supplementary controls accomplish (1) Backwashing, (2) Regeneration of anion and cation resins, (3) Mixing the resins, (4) Return to deionizing.

Incorporates ELGIN *"Double-Check" principle*

Note that the Elgin "Double Check" manifold design, well known for its ability to increase the capacity of zeolite water softeners and to prevent loss of zeolite or exchanger, is used in these Elgin Deionizers. Where valuable resinous exchangers are used as required in deionization, the use of the "Double Check" principle is especially important.

48 man-hour job done in only 4 hours with a ROTO Hand-hole Seat Scraper



Illustrating ease of operation of Roto Hand-hole Seat Scraper.

If you operate any of the boilers listed below, you can't afford to be without a ROTO Hand-hole Seat Scraper.

A Pennsylvania manufacturer reports that it formerly took three men 2 to 3 days to clean inside cap seats on a Keeler Boiler header. Now, with a ROTO Hand-hole Seat Scraper, one man does it in four hours, besides doing a better job.

This simple, hand-operated tool is equipped with retractable knives mounted on the end of a revolving spindle having a bearing in a substantial yoke. An adjustable spring automatically maintains tension on the knives, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right, and the job is done. A half turn to the left releases the tool. Write for bulletin and prices.

MAKE OF BOILER	TUBE SIZE	OPENING
Babcock & Wilcox	4"	Oval
B. & W. No. 40 Header	3¼"	Oval
B. & W. No. 41 Header	2"	Oval
B. & W. Superheater	2"	Round
Babcock & Wilcox	4-13/16x5"	Square
Casey Hedges	4"	Oval
Cases Hedges	3½"	Oval
Combustion Engineer'g	3"	Round
Edge Moore	4"	Oval
Franklyn	4"	Round
Geary	4"	Oval
Heine	3½"	Oval
Heine	3½"	Round
Keeler	4"	Round
Keeler	4"	Diamond
Murray	4"	Oval
Murray	3½"	Oval
Oil City	4"	Oval
Oil City	3½"	Oval
Union Iron Works	4"	Pear Shape
Walsh & Widener	4"	Oval

ROTO Hand-hole Seat Scraper for Heine Boiler.

ELLIOTT COMPANY-ROTO DIVISION
153 Sussex Avenue Newark 1, N. J.

POWER NEWS

(*Continued from page 142*)

Sydney, Australia Increases Steam

McGraw-Hill World News: As a shortcut to supplying badly needed capacity the Sydney County, Australia, Electricity Council is putting in two 165,000-lb-per-hr 650-psi 850-F Velox boilers and auxiliary equipment at its Bunnerong power plant. The installation will increase station output by 30,000 kw.

Greatest advantage of the Velox steam generators from the Council's standpoint is that delivery and installation can be effected in 2½ years, about half the time for a conventional plant from the usual British supply sources. Capital cost is relatively low.

But the one serious disadvantage is the need for gas or oil fuel, neither of which is readily available in Australia. This means that eventually the equipment will be relegated to the role of a standby installation.

Largest High-Capacity Short-Circuit Station

New high-capacity, short-circuit testing station, the largest of its type in the world, will be used to test switchgear equipment for General Electric Co's switchgear division.

The test station, near the company's Philadelphia, Pa. plant, will be capable of (1) delivering three million kva at generator voltages on a 3-phase symmetrical basis (2) testing power circuit breakers and other switchgear apparatus at voltages up to and including 440,000 volts.

The test building will contain a generator room, enclosing the two main generators, reactors and protective switchgear, and a large assembly room. Five test cells will be placed alongside the assembly room. Adjoining one of the cells will be a bank of transformers to provide low voltage, high current power for that cell.

Southeastern Utilities Begin Expansion

Southeastern public utilities have set upon a $1,220,820,000 5-year program, according to M C Wilson, Georgia Power Co, to keep ahead of the rapid industrial growth in the Southern states.

In the last decade the South has expanded industrially by 250% as compared with a national rate of 200%. About 14 Northern concerns are now planning some 16 Southern plants to cost $75,000,000.

The Russian situation, said Wilson, has caused industrialists to think long and hard about new plant locations. The large forest area of the South has attracted pulp and paper people to where property value of these companies total $1,000,000,000.

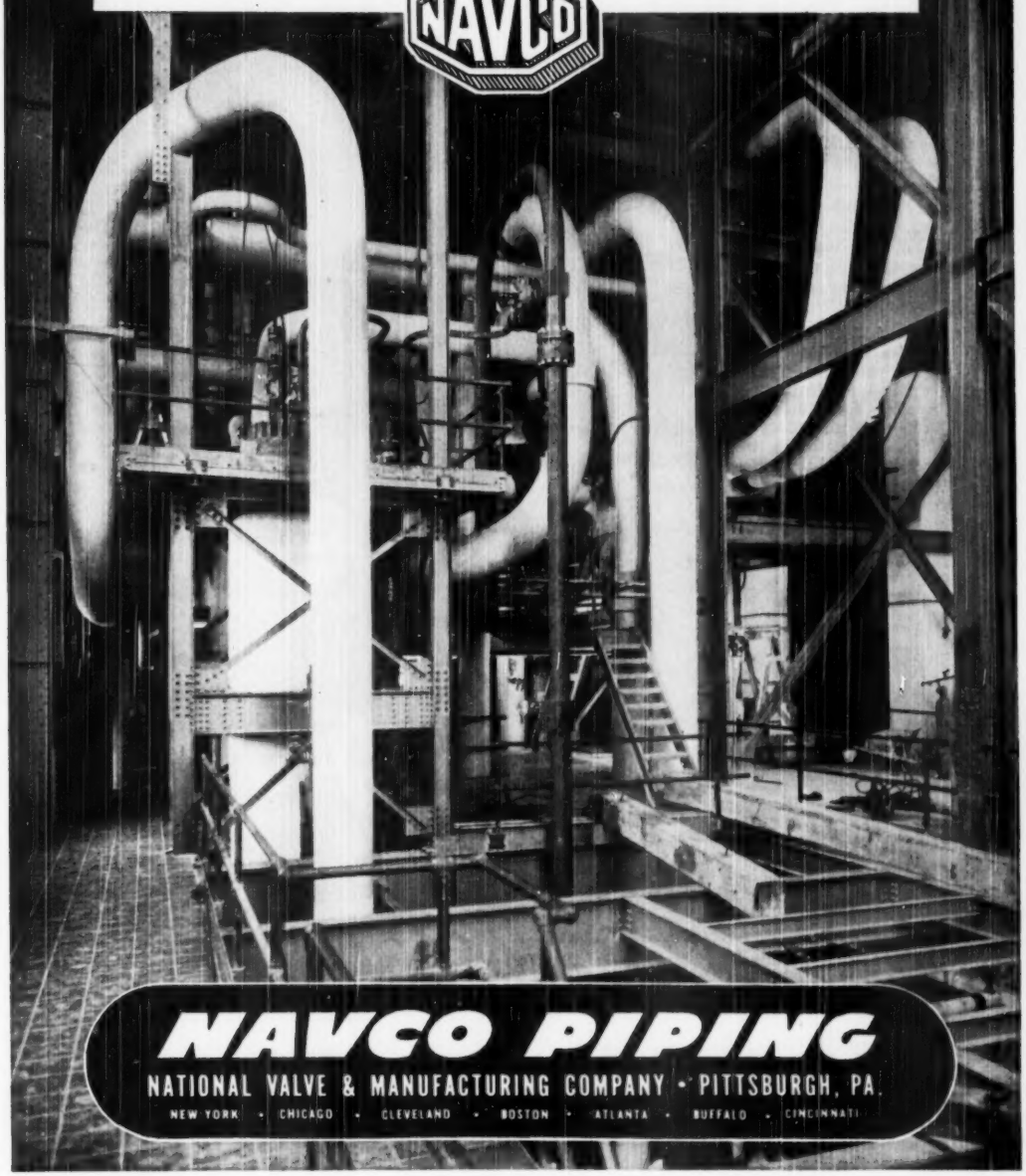
Latest development is a projected construction of an $18,000,000 plant near Pisgah Forest, N. C., for 30,000,000 lb per year of cellophane.

It pays to get NAVCO'S "Know How" and experience in High Pressure and High Temperature piping

For almost half a century Navco has specialized in the fabrication and erection of Piping Systems for the highest operating conditions.

The experience gained throughout that period is your assurance of obtaining from Navco, a Piping System of the highest order.

NAVCO

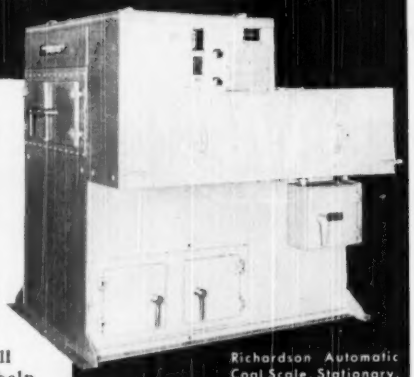


NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • BUFFALO • CINCINNATI

KEEP YOUR B.E. UP YOUR COAL COSTS DOWN...



Richardson Automatic Coal Scale, Stationary, Floor Mounted Style.

1 **Richardson Coal Scales**—Low B. E. (boiler efficiency) and costly coal waste are quickly signalled, the moment they begin, when you install a Richardson Coal Scale over each boiler. You get a detailed record of coal consumption by the hour, shift, day, week or month. By checking on all forms of coal waste they help to keep your power costs at a minimum!

2 **Richardson "Monorate" Distributors**—Designed by Richardson engineers for preventing coal segregation in stoker fired installations, the curved top plate of the "Monorate," causes all coal, *lumps and fines,* to fall at the same rate. It eliminates the tendency for the mixture to separate. This insures a uniform spread over your stoker hopper . . . a prerequisite for efficient combustion.

Richardson "MONORATE" Distributor showing patented curved plate which prevents separation of lumps and fines.

A complete Richardson Installation Provides:
Leakproof Gate from the bunker, Flexible Inlet to scale, Automatic Coal Scale, "Monorate" Non-Segregating Distributor to stoker or Down-take Chute to pulverizer.

Richardson engineers will be glad to discuss your coal consumption problems. For complete details on Richardson Coal Scales write for Bulletin No. 1143. Bulletin No. 1349-P gives complete information on the "Monorate."

CLIFTON, NEW JERSEY

Atlanta • Boston • Buffalo • Chicago • Minneapolis • Wichita
New York • Omaha • Philadelphia • San Francisco • Houston
Montreal • Toronto • Cincinnati • Detroit • Pittsburgh

Richardson

Materials handling by weight

6363

APPOINTMENTS

Nordberg Mfg Co appoints James A Friend senior vice-president of the concern. James Friend, former vice-president

James A. Friend

and purchasing agent, takes over the duties of F Howard Kilberry, recently resigned.

Jaeger Welding Supply, Inc, Springfield, Mass., and Texas Welding Supply Co of Dallas, Texas, have been appointed distributors for the **Ampco Metal, Inc** line in their respective areas.

Walter Feist has been elected to his ninth term as president of **Allis-Chalmers Mfg Co.** W C Johnson has been reelected executive vice-president; W A Roberts, executive vice-president in charge of the tractor div; E H Brown, vice-president in charge of engineering development, W E Hawkinson, secretary and treasurer; J A Keogh, vice-president and comptroller; J L Singleton; vice-president and director of sales for the general machinery div; H W Story, vice-president and general attorney.

American Pulley Co announces the appointment of John T Barron as manager of its Power Transmission div.

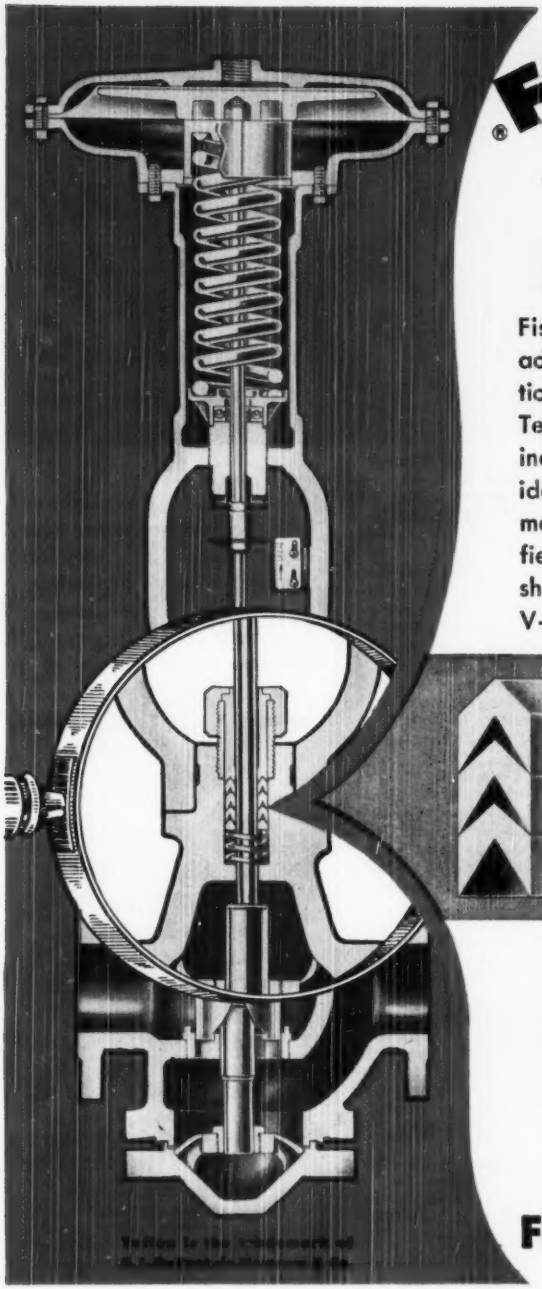
New assistant general sales manager for the **Airtemp Div** of Chrysler Corp will be J F Knoff, formerly director of packaged cooling.

American Engineering Co has just appointed J C Mevius to the post of sales manager, for the Hydraulic div.

Cyclotherm Corp has inaugurated a national plan of sales and service by setting up additional distributors as well as a branch office in New York City under Emil Zisek. Distributors are: Rumbold and Co, Inc, Atlanta, Ga.; Phillips Engineering Co, Detroit, Mich.; Bingham and Risden Co, Green Bay, Wis.; General Industrial Supply Corp, Fort Worth, Texas; Roytser H Johnsen Co, Charlotte, N. C.; Dempster Brothers, Knoxville, Tenn.; Keady Sales Corp, Chicago, Ill.; Air Conditioning Engineers, Inc, Mobile, Ala.; Flogg, Brackett & Durzin, Inc, Boston, Mass.

Full-time services of Robert P Ramsey, industrial market-research and product-design consultant, is evidence of the expanded

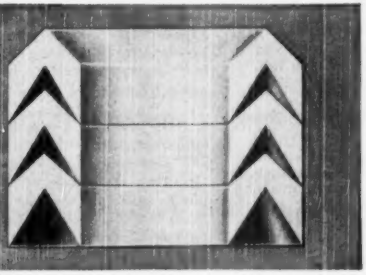
IT'S *New* AND A *Natural*



FISHER® *Teflon*

V-RING PACKING

Fisher Teflon V-ring Packing has been adopted as standard available construction for all Fisher diaphragm motor valves. Teflon is tough, resilient, and chemically inert. Its smooth soap-like surface makes it ideal packing for control valves. After more than two years of laboratory and field testing Teflon in various forms and shapes, Fisher engineers decided upon the V-ring construction as ideal for packing.



Fisher Teflon packing cut in section to show V-ring construction.

Advantages of Fisher Teflon V-ring packing:

- ***Economical***
- ***Minimum leakage***
- ***Low maintenance***
- ***Reduction of packing friction***
- ***No corrosion***
- ***No product contamination***

FISHER GOVERNOR CO.

MARSHALLTOWN, IOWA

Discarding condensate because of OIL?

If you are throwing away valuable condensate rather than risk its return to the boiler because of oil contamination, filtration with Sorbo-Cel may be the answer to your problem.

Low in Cost

This specially processed diatomaceous silica powder provides a simple, economical method of removing emulsified oil from water and thereby obtaining an oil-free condensate for boiler feed or other use. Total cost ranges from only 1¢ to 3¢ per 1000 gallons of water filtered.

How it works

A small amount of Sorbo-Cel is simply mixed with the oil-contaminated water, which is then pumped through a pressure filter. Here the oil globules are removed by the specially treated Sorbo-Cel particles, and both are retained upon the filter screen. The filtered water alone passes through.

Does complete job

Sorbo-Cel does a complete job of oil removal. In addition, it removes other suspended matter such as rust, scale, clay and precipitates. And its action is so efficient that large volumes of water can be filtered in a relatively short time.

A bulletin that gives further facts about this low-cost way to remove oil from water is available on request. Just use the coupon below.

JM

Johns-Manville SORBO-CEL

Johns-Manville
Box 290, New York 16, N. Y.
Send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

Company_____

Address_____

City_____ State_____

POW-7

market-analysis program of **Cooper-Bessemer Corp.**

Olney John Hawkins, chief of project operations and maintenance branch, Portland district, Corps of Engineers, has accepted position of port engineer in Turkey for **Koppers Co, Inc.**

Diamond Power Specialty Corp has appointed Lyle B Schueler, sales manager. Schueler was formerly with the American Gas and Electric Service Corp as assistant chief mechanical engineer.

Wm W Jamieson became vice-president, industrial sales, and Lewis C Blackhall, assistant vice-president of **Dearborn Chemical Co, Toronto.**

M A King, engineering vice-president, **Elliott Co,** has been named a Fellow of the ASME.

Muth-Richards Co are the new representatives in the state of Washington and the panhandle of Idaho for the **Electric Products Co.**

Thomas O Schrader, Jr, has become sales manager for the **Erie City Iron Wks** to succeed Dudley Selden, who is retiring.

Charles Edison, president of **Thomas A Edison, Inc** for the past 24 years, was elected to the newly created post of Chairman of the Board of Directors and Henry G Riter, 3rd, succeeded to the presidency.

R H Olson, former vice-president in charge of sales, has been made president of **Electric Machinery Mfg Co.** His former position will be filled by A P Burns, and P L Shawley will handle the New York district.

Fisher Governor Co, manufacturers of pressure and liquid-level control equipment, have begun manufacture in England with a new office and plant in London.

L D Whitescover has been appointed assistant manager of the Lynn, Mass, turbine and gear sales div of **General Electric Co.** His post as manager of the Fitchburg turbine sales div will be filled by F S Kohl, formerly assistant manager. Thomas Sproule becomes the assistant manager of manufacturing at Fitchburg.

Albert E Bickell has been appointed assistant district sales manager for the **General Refractories Co,** Pittsburgh office.

Hall Laboratories has made Charles E Kaufman assistant director of research. He succeeds Dr E P Partridge whose appointment as director was recently announced. J N Welsh, director of engineering research, has become associate director of the firm.

Dr Thomas H Daugherty, assistant director of research for **Calgon, Inc,** has been named director to replace Dr E P Partridge, now director of Hall Laboratories, an associated firm in the Hagan Corp group.

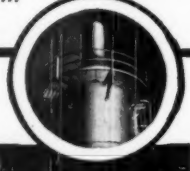
(*Continued on page* 208)

If your plant requires

- DIRECT HEATING OF VAPORS
- DIRECT HEATING OF LIQUIDS
- DOWTHERM INDIRECT HEATING
- STEAM GENERATORS
- STEAM SUPERHEATERS
- WASTE HEAT BOILERS

place the selection of the specific type in specialized hands . . . and obtain optimum efficiency.

Petro-Chem Development Company engineers are heating specialists . . . they can supply the whys and wherefores of indirect versus direct heating and the economics of both.



Every day more than 600, oil and gas fired, Petro-Chem Iso-Flow* installations in the petroleum, chemical and allied industries, demonstrate the efficiency of their design and installation.

**Patents issued and pending*

PETRO-CHEM DEVELOPMENT CO., INC.
120 East 41st Street, New York 17, N. Y.

Representatives:
Bethlehem Supply, Tulsa and Houston • Flagg, Brackett & Durgin, Boston • D. D. Foster, Pittsburgh • Faville-Levally, Chicago • Lester Oberholz, Calif.

Jeffrey Spiral Conveyor shown here is handling lime and alum in a large Water Works plant. Note the clamped cover used when dusty material is encountered . . . also the various rack and pinion valves in trough bottom for delivery of material when and where needed. A spiral flight is shown also.

THE SPIRAL CONVEYOR IS A COMPACT UNIT

You can save time and money by using a Jeffrey Spiral Conveyor. A neat and compact installation — no return strand. Capacities vary with size of conveyor. Handles many kinds of material at low cost.

Sectional, Flight, Helicoid, Mixer, Cut Flight, Ribbon and Cast Iron . . . six types manufactured by modern methods with equipment especially designed for the purpose. Uniform strength, perfect fit and true alignment assured.

Jeffrey Spirals are interchangeable with other standard makes . . . are built to industrial standards. Try one on your next handling job whether it's coal, raw sugar, grain, salt cake, cement, carbon black, grape fruit or orange rinds, etc.

Catalog No. 803 fully describes and pictures Jeffrey Spiral Conveyors. Send for it today.

THE JEFFREY MANUFACTURING COMPANY Established 1877

932 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

Baltimore 2, Birmingham 3, Boston 16, Buffalo 2, Chicago 1, Cincinnati 2, Cleveland 13, Denver 2, Detroit 13, Harlan, Houston 2, Huntington 19, Jacksonville 2, Milwaukee 2, New York 7, Philadelphia 3, Pittsburgh 22, St. Louis 1, Salt Lake City 1, Scranton 3

Jeffrey Mfg. Co., Ltd., Head Office & Works: Montreal

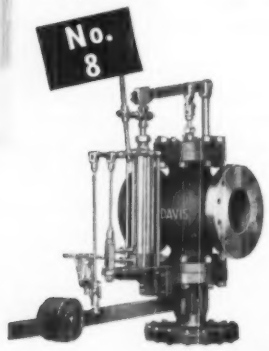
—everything YOU want in

PRESSURE REGULATORS

The DAVIS Line is Complete!

No. 401—Designed to give you everything you want in a sensitive diaphragm motor valve and pressure controller for pressure reducing service on steam, air, or gas. The controller may be mounted on the valve or installed remotely on an instrument panel. The valve is a spring loaded, balanced disc type of rugged construction suitable for indoor or outdoor installation. Offered in a complete range of sizes from ½" to 10" for initial pressures to 600 p.s.i. and any reduced pressure from 500 down to 1 p.s.i. Ask for descriptive literature.

No. 40—This is a simple, self-contained, pilot operated type reducing valve for handling heavy, variable loads on steam or air. Unaffected by high pressure fluctuations, pressure reduction is maintained regardless of flow conditions. Full pipe size port area gives large capacity; single seat insures tight closing. Sizes from ½" to 6". Available in materials suitable for any initial pressure up to 400 p.s.i.



No. 8—Built for handling steam at pressures ranging as high as 600 p.s.i. Pilot controlled and weight loaded, with auxiliary operating cylinder, this valve provides exceptionally accurate regulation for reduced pressures from 0 to 300 p.s.i. Sizes from 2" to 24".

Let Davis help you get the right regulator for the job. The Davis line is complete . . . 18 types to choose from . . . ask for bulletin.

DAVIS REGULATOR COMPANY

2540 So. Washtenaw Ave., Chicago 8, Ill.

DAVIS

ASK FOR NEW CATALOG A-50

AUTOMATIC PRESSURE, FLOW, AND LIQUID LEVEL CONTROLS SINCE 1875

I-T-E Circuit Breaker Co elected William Deans, chief engineer to the position of vice-president in charge of engineering. G E Heberlein, chief engineer of the subsidiary Railway & Industrial Engineering Co, has been elevated to manager of the switchgear division of I-T-E.

Lloyd J Hughlett, former McGraw-Hill International Corp editor of Spanish language engineering publications, has joined the staff of **Arthur D Little, Inc.**

A F Boucher has assumed sales and engineering responsibilities for the **Lincoln Electric Co** in Detroit. I R Barter moves over to Milwaukee from Grand Rapids.

Leeds & Northrup Co have opened a new sales and service office in Seattle for the Pacific Northwest under Stratford B Biddle, Jr, as manager and Ira F Omwake, Jr.

Hamilton Merrill, vice-president and director of **Manning, Maxwell and Moore, Inc,** has been appointed vice-president in charge of the Consolidated-Ashcroft-Hancock div.

A southeastern sales region has been set up by **National Electric Products Corp** under Walter J Barnes as regional manager.

V V Malcolm, manager special industries dept, **Philip Carey Mfg Co,** has been elected a director of the National Association of Corrosion Engineers.

F H Kilberry, formerly of Nordberg Mfg Co, has become management consultant for the **Superior Engine Div** of the National Supply Co.

Donald M Quick has been appointed assistant to the chief engineer, electric engineering dept of **Public Service Electric and Gas Co.**

Gene D Sichert has been made works manager for the Indianapolis plant of the **Peerless Pump div,** Food Machinery and Chemical Corp.

Pennsylvania Crusher Co elected J William Schulze president, John A Plimpton, vice-president, and John R Newell, also a vice-president.

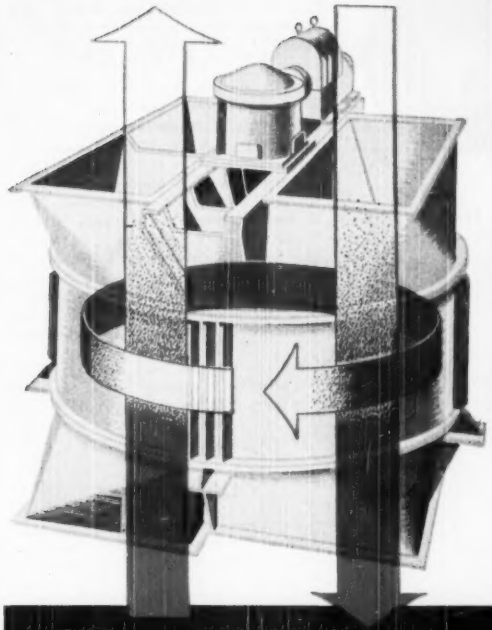
Purolator Products, Inc is now located in its new plant in Rahway, N. J.

G W Bush Co, West Hartford, Conn., has become a new distributor for the **Sier-Bath Gear & Pump Co.**

George Skipton, application engineer for the transportation div of **Westinghouse Electric Corp** in San Francisco, has been placed in charge of all company activities dealing with the supply of electrical apparatus in the city and county of San Francisco.

Caxton Brown has been retired as chairman of the executive committee of **Weston Electrical Instrument Corp.** He will retain his post on the board of directors.

(*Continued on page* 210)



this preheater can save you money whatever your fuel

the *Ljungstrom* AIR PREHEATER

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

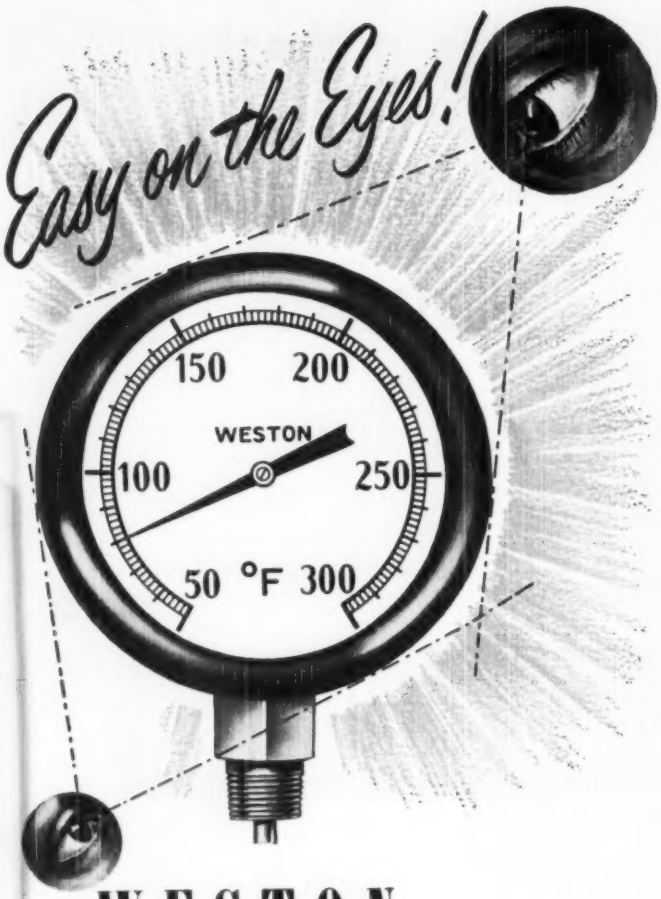
All fuels burn better with preheated combustion air, and it is a "must" for many of them, such as high moisture powdered coal. In addition, the *continuous regenerative counterflow* principle of Ljungstrom permits reliable operation at low exit gas temperature. This assures the greatest possible heat recovery . . . reduces the amount of fuel required.

The efficiency and reliability of the Ljungstrom air preheater is a matter of record in industrial and utility plants throughout the country. That is why every year a constantly increasing percentage of the installed boiler capacity is equipped with Ljungstrom air preheaters.

If you are planning a new installation, or modernizing your present one, our engineers will welcome the opportunity to show you how the Ljungstrom can raise the efficiency of your plant.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.



WESTON *All-Metal* THERMOMETERS

Easy on the eyes—that's just one feature that makes easy-to-read Weston Thermometers the answer to your temperature measuring problem.

Easy on the mind—you can relax when Weston All-Metal Thermometers are supervising important industrial processes.

Easy on the budget, too—Weston All-Metal Thermometers deliver dependable, faithful service . . . year in, year out.

Be sure to check your Weston Representative—or write Weston Electrical Instrument Corporation, 679 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and Tagliabue instruments.

WESTON *Instruments*

Charles A Butcher, formerly general manager of Crocker-Wheeler Electric Mfg Co, has joined **Worthington Pump and Machinery Corp** as assistant to the president.

Orest A Mevkar, mechanical engineer for **Buchans Mining Co, Ltd,** has been transferred to a mechanization project under way in Newfoundland.

Vice-president W O Lippman, formerly in charge of plant relations, has become head of the **Westinghouse Elevator div** at Jersey City; Vice-president Tom Turner goes from the elevator div to the post of plant labor-relations director at Pittsburgh. O J Maslin has been appointed assistant to the engineering manager of the transformer div, **Westinghouse Electric Corp.**

John J Reagan has been assigned to the Charlotte, N. C., district office of **Allis-Chalmers Mfg Co** as sales representative.

OBITUARIES

Gus S Hyatt, 46, department comptroller, **General Electric Co** apparatus dept, died suddenly, April 30 at his Schenectady, N. Y. home.

W H Thorp, **Wm Powell Co,** died after a brief illness in Worthington, Ohio, May 10.

Joseph E Holveck, 67, hydraulic engineer, **Worthington Pump and Machinery Corp,** died May 20 at Mountainside Hospital, Montclair, N. J.

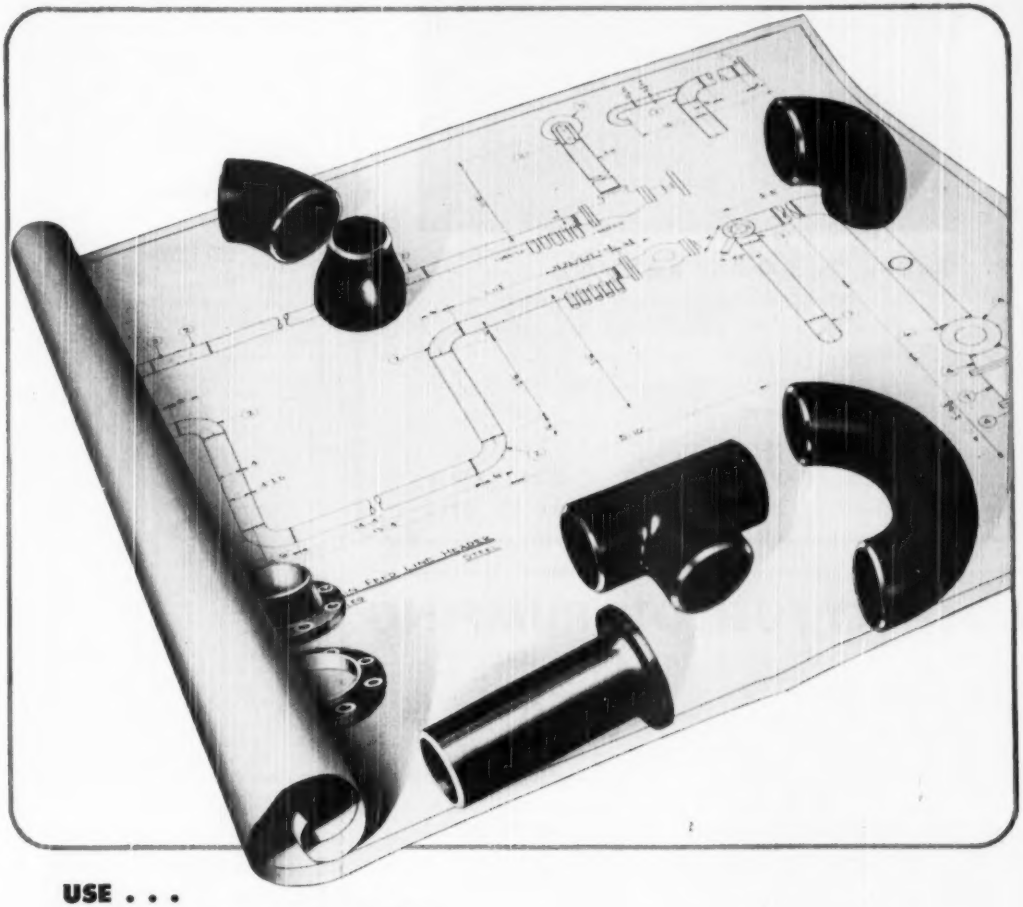
George R Probst, 54, manager of steam turbine sales, **Moore Steam Turbine div,** Worthington Pump and Machinery Corp, died in Wellsville, N. Y., May 14, 1950.

Economic Corporation Adm has given final approval to a giant plan to supply Greece with electrical energy, according to a McGraw-Hill World News report. The plan calls for: (1) generating station in Euboca together with a hydroelectric scheme on the River Laden (2) hydroelectric system in the village of Agra (3) hydroelectric system on the River Louros. Total program will provide 1100 million kwhr annually.

Board of Public Service, St. Louis, Mo., presented through its president, Frank J McDevitt, a plan to the city for a 3,800,000 system to produce electricity from the burning of rubbish in two proposed city incinerators. Cost of the plan will overrun by $1,800,000 the original $2,000,000 provided in a 1946 bond issue to finance the incinerators. McDevitt said the plants will pay for themselves in five years with an estimated revenue of $504,000 a year.

William G Christy, former smoke-abatement engineer for Hudson County, New Jersey, has been appointed director of the **Bureau of Smoke Control** for the city

TO DO A BETTER PIPING JOB . . .



USE . . .

GLOBE PRECISION PROCESS SEAMLESS WELDING FITTINGS

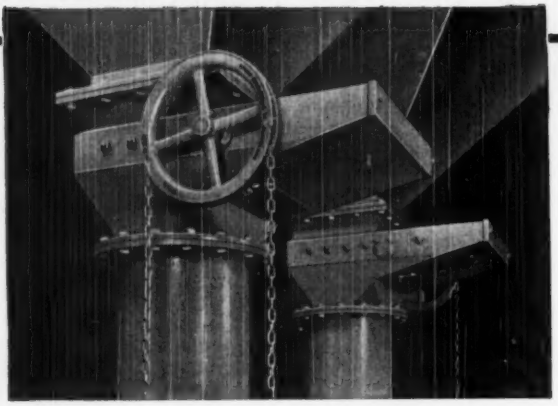
When you specify and use Globe Welding Fittings you have the product of an organization with unusually broad metallurgical experience. Globe's precision-process method of production reaches back to the manufacture of the Globe seamless tubes themselves which are the "raw material" of Globe welding fitting fabrication.

GLOBE STEEL TUBES CO., Milwaukee 4, Wisconsin

Chicago • Minneapolis • Cleveland • Detroit • New York • Philadelphia St. Louis • Tulsa • Houston • Denver • San Francisco • Glendale, Cal.

Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe Welding Fittings.

Send for the Globe Welding Fittings Catalog—and look to Globe as a preferred source of supply.



S-E-CO. COAL VALVES are available in many sizes and types. Sizes range from 6" to 30". Either round or square flanges are available. Top of valve may be flanged or equipped with studs. Handwheel or chain operation available.

Write for dimension sheets

STOCK EQUIPMENT COMPANY
715P Hanna Building ★ Cleveland 15, Ohio

LOCKETT FUEL OIL PUMPING AND HEATING SETS

Custom Built

The efficient, compact unit illustrated consists of two Worthington Duplex Steam Pumps and two Griscom Russell Twin G-Fin Fuel Oil Heaters mounted on a single structural steel frame.

FOR almost a half century, Lockett has been supplying, to fit individual needs, efficient standard and custom-built, Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Combinations of various types of pumps are available: Either two Turbine-driven Pumps; one Electric-driven and one Turbine-driven Rotary Pump; two Electric-driven Rotary Pumps; two Worthington Duplex Steam Pumps; or one Duplex Steam Pump and one Electric-driven Pump. Each pump-and-heater is suitable for the full rated capacity of the unit; the second pump and heater are spares. Lockett supplies everything, complete. Inquiries are invited. *Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.
Contracting Mechanical Engineers
NEW ORLEANS - HOUSTON - DALLAS - GALVESTON

of New York. Rear Admiral W S Maxwell, retired, will be deputy director. Both men were recommended to the city by a committee of seven engineers appointed by ASHVE, ASME and NAPE. P W Swain, editor of **Power,** was a member of this committee.

AIEE in their summer Pacific general meeting heard from I W Collins of Pacific Gas and Electric Co that while water power is vital to northern and central California its relative importance is decreasing. In 1920 hydro plants produced 62.7% of the total power; in 1930 it was 71%, but by 1940 it had dropped to 64.8%. Steam has generated the remainder.

Keswick Dam Plant In Operation

Keswick Dam power plant, a few miles downstream from California's Shasta Dam, went into full operation March 31 with the throwing of the switch on the third and last generating unit. This completes all authorized hydropower generation facilities on the Sacramento River in the Bureau of Reclamation's Central Valleys Project.

Power from Keswick's three 25,000-kw units is being sold to Pacific Gas & Electric Co. Added to the 375,000 kw produced by Shasta power plant, the second unit of the initial CVP program, Keswick brings the total of present CVP capacity to 450,000 kw.

Tacoma Plans to Extend Cushman

First major project, in a $12,000,000 program approved by the Tacoma, Wash. city council for enlarging and improving its municipal lighting system, will be construction and installation of a third generator in the Cushman No. 2 powerhouse. The generator, rated at 30,000 kw, will cost about $1,870,000, with the additional penstock and turbine installation. Second major item of the program will be progressive development of substation facilities south of Tacoma.

Booklet to Interest Compressor Designers

COMPRESSIBILITY CHARTS AND THEIR APPLICATION TO PROBLEMS INVOLVING PRESSURE-VOLUME-ENERGY RELATION FOR REAL GASES, *25 pp, 8½x11, 7 charts, illust, tables, paper; available from Worthington Pump and Machinery Corp, Harrison, N. J.*

Bulletin details novel method for estimating energy transformations involved in pressure-volume change for gases. Formulas and compressibility charts are applicable to specific compressor problems. Results are sufficiently accurate for most engineering problems.

Real gases, horsepower equations for real gases and flow through nozzles are considered. Numerical examples show typical applications. Being a rather complete discussion, this booklet should be of interest to all compressor designers.

Installation Techniques are "Pay-off"...

With modern operating temperatures ranging as high as 1050°F. and pressures climbing upwards of 2,000 psig., welding and concurrent heat treating of alloy power piping *during installation* pose critical problems for field crews.

For example, the weld shown in the illustration required a heat treating cycle of over 15 hours. During this time Kellogg crews, using special induction heating equipment, raised the temperature of the weld area at a predetermined controlled rate over a period of some four hours. Upon reaching the proper pre-heat temperature, welding was started as shown in the picture.

As the weld was made the temperature was naturally held at a uniform level. Upon completion, the weld was stress-relieved at a predetermined elevated temperature for over two hours and then allowed to cool at a controlled rate for four hours to complete the cycle.

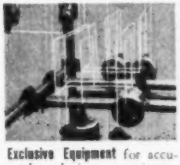
Over the years such special techniques in connection with welding alloy piping have been developed by Kellogg engineers, who have been entrusted with such recent innovations in power piping as the first HT-HP stainless steel installation and the fabrication of piping for the original 1050°F. station.

The experience of these well-trained field installation crews is one "plus value" obtained when power piping by M. W. Kellogg is specified.

Illustrated—Inspector checks laying of first bead.

Special studies of unusual problems such as graphitization to assure long life and low maintenance.

Metallurgical research by recognized specialists who have made major contributions in this field.



Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

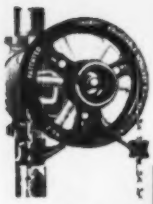
Top welding performance in shops and in the field by welders accustomed to working under X-Ray checks.

Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

Vessels
Exchangers
Condensers
Process Piping
Forged and Welded Fittings
Radial Brick Chimneys

★

The M. W. Kellogg Company, Inc. (A subsidiary of Pullman Incorporated) Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.



HELP!

FOR EVERYONE WHO HANDLES VALVES OR PIPING

Babbitt *Adjustable* SPROCKET RIM *with Chain Guide*

• Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

• Control overhead valves with ease and certainty, no matter how high up—right from the floor! No more climbing on bench, machine, boiler, treacherous stepladder. For overhead pipe layouts, plan on putting valves wherever needed. The BABBITT adjustable Sprocket Rim with Chain Guide is especially designed for easy, positive control of those out-of-reach valves—from the floor.

• The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

• *Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.*

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Mass.

industrial
OIL AND GAS BURNING EQUIPMENT

- Mechanical Atomizing Oil Burners
- Steam Atomizing Oil Burners
- Refractory Burner and Muffle Blocks
- Industrial Gas Burners
- Low Air Pressure Oil Burners
- Fuel Oil Pump Sets
- Valves, Strainers, Furnace Windows
- Tandem Block Combustion Units
- Combination Gas and Oil Burners

Detailed information gladly sent you upon request.

NATIONAL AIROIL BURNER

NATIONAL AIROIL BURNER COMPANY INC.
1250 East Sedgley Avenue, Philadelphia 34, Pa.
Southwestern Division:
2512 South Boulevard, Houston 6, Texas

TECHNICAL BRIEFS

In addition to the reports on page 138, here are briefs for:

Synthetic Fuels
Future Fuels
Firing Fuels
District Heating
Turbine Operation
Refrigeration

SYNTHETIC FUELS

INDUSTRIAL FUELS FROM OIL SHALE, *by Boyd Guthrie and R J Cameron, Bureau of Mines, Rifle, Colo.* Oil shale is sedimentary rock that contains a solid, organic material known as kerogen. When this rock is heated to 800 F or so, the kerogen converts to shale oil, a combustible gas and a carbonaceous residue. This process is known as retorting. The residue can be burned to supply more heat than is required to decompose kerogen. Shale oil can be refined to produce fuels similar to those from petroleum.

Oil shales are widely distributed both geographically and geologically. They appear in abundance in certain sections of all the continents and range in age from early Paleozoic to late Cenozoic. Such deposits occur most abundantly in Europe, Australia, Manchuria, North America. Reserves in the U. S. are capable of yielding shale oil in quantities that dwarf our present known petroleum reserves.

Of the known 2592 square miles of oil shale in Colorado a 1000-sq-mi area has been well defined by core drilling and surface sampling. It has been estimated that this area would yield about 300-billion barrels of oil from a 500-ft thick deposit that assays 15 gal of oil per ton of shale.

At present, two methods of refining appear attractive. One uses conventional thermal cracking techniques to yield gasoline, distillate, residual fuels, coke. The other method is hydrogenation.

Depending on the process, different industrial oils can be produced. Their performance against those originating from petroleum seems promising. *MW P paper. No number.*

FUTURE FUELS

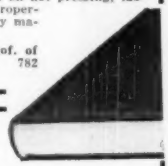
COAL'S PLACE IN THE SUN, *by Bertrand A Landry, Battelle Memorial Institute, Columbus, Ohio.* To the author's way of thinking, there are three questions that come to mind: (1) What is coal's importance in relation to its principal competitors, oil and gas? (2) What are the competitive aspects in the immed-

New Third Edition

REFRACTORIES

Here is a comprehensive guide to modern standards and practices in the manufacture, testing, and use of refractories. Provides timely information on refractories for jet propulsion and nuclear power generation . . . non-plastic casting . . . hydrostatic molding, etc. This revised edition includes new material on hot pressing, laboratory furnaces, properties of pure refractory materials, and molding.

By F. H. Norton, Prof. of Ceramics, M.I.T., 782 pages, $10.00.



HEAT PUMP APPLICATIONS

This new book provides a practical discussion of industrial, residential and commercial applications of the heat pump, including its operation, performance, and potentialities. Covers heat pump cycles, the thermodynamics of the heat pump, and includes temperature and design data. Describes compressors, fans and ducts, electric motors and accessories.

By E. Kemler, Associate Director, Southwest Research Inst., and S. Oglesby, Purdue U., 300 pages, $6.00.

OIL BURNERS

New 2nd Edition gives the designer, installer, service man and user practical information on design, production, installation and operation of domestic, commercial and industrial oil burners. Discusses electronic control methods; refractories; capacity of boilers and warm-air furnaces; draft and combustion control; building temperature control methods and fluid flow.

By K. Steiner, Fuel Engineer, C. Hoffberger Co., 502 pages, $6.50

ELECTRICAL MACHINES
Direct and Alternating Currents

New book provides a detailed discussion of all types of modern electrical power equipment, generators, motors, transformers, converters and control devices. It emphasizes the practical applications and operations of elementary and more complex machines, and stresses the underlying principles of electrical machines and accompanying circuits.

By C. S. Siskind, Asst. Prof. of Elec. Engr., Purdue U., 521 pages, $4.75.

SEE THESE BOOKS 10 DAYS FREE

McGRAW-HILL BOOK CO., Inc.
330 W. 42nd St., New York 18

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery, and return unwanted book(s) postpaid. (We pay for delivery if you remit with this coupon; same return privilege.)

- ☐ Norton—Refractories, 3rd—$10.00
- ☐ Kemler and Oglesby—Heat Pump Applications—$6.00
- ☐ Steiner—Oil Burners, 2nd—$6.50
- ☐ Siskind—Electrical Machines—$4.75

Name
Address
City Zone State
Company
Position P-7-50

This offer applies to U.S. only

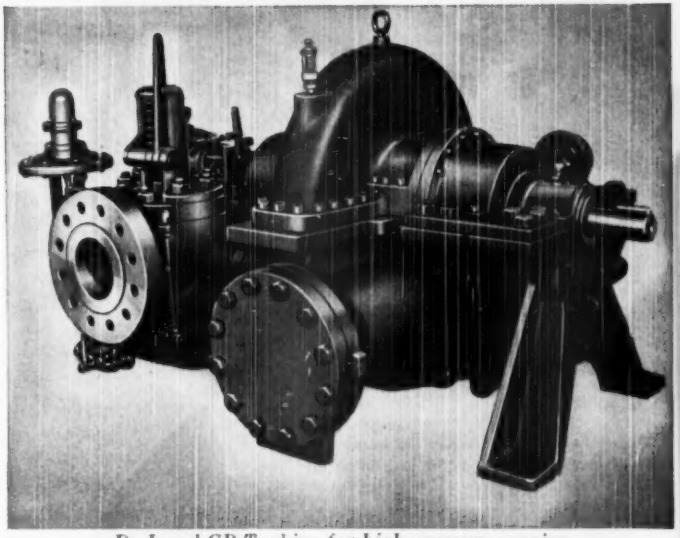
A NEW SINGLE-STAGE TURBINE DESIGNED ESPECIALLY FOR HIGH PRESSURES . . .

Initial pressures to 1450 psig .. Back pressures to 300 psig

THE FIRST SINGLE-STAGE TURBINE WITH ALL-LABYRINTH SHAFT SEALING

This new, high pressure single-stage turbine is more than an ordinary single-stage turbine in a "beefed up" high pressure casing. It is the *first* single-stage, mechanical drive turbine with all labyrinth shaft seals of the type generally used in large, multi-stage turbines especially designed for high pressure service.

Steam leakage along the shaft is effectively prevented by a labyrinth seal consisting of a series of shaft grooves and mating tongues of stainless steel—as many as 52 labyrinths per side being employed for the highest pressures. The labyrinth seal reduces losses, lasts longer and require less maintenance than carbon rings subject to wear.



De Laval CP Turbine for high pressure service.

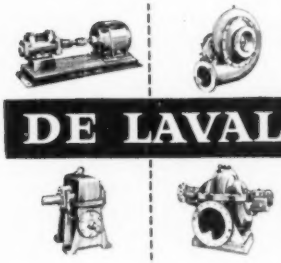
When you buy a De Laval CP Turbine you also get...

True center-line support—to provide for thermal expansion without disturbing shaft alignment.

Choice of eight governing systems—to meet every control requirement.

Independent, positive over-speed trip entirely independent of the governing system for positive protection.

Horizontally split casing with steam chest in bottom half. The cover can be lifted without disturbing piping connections.



DE LAVAL

The De Laval CP Turbine is made in three sizes for capacities up to 2000 hp. For further information write for Bulletin 4215-33A-P.

DE LAVAL STEAM TURBINE COMPANY, TRENTON 2, N. J.

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

T-33A

I'm looking for a Soft Touch!
Equipment that's too hot to touch is obviously a soft touch for the escape of power-laden Btu's . . . a fat touch on your fuel dollars!
Check power losses, cut production costs, raise efficiency and employee morale with fuel-saving, CAREY Industrial Insulation.
And to keep Btu's on the job at high temperatures—here's a new, improved insulation
Carey Tempchek
a brand new material with a low K-factor, rugged strength, excellent "handle-ability," and a temperature range up to 1500° F.
a combination of qualities that can't be beat
Ask about it!
CAREY Makes The Complete Line
85% Magnesia—Industrial Rock Wool
Asbestos—Pipe Coverings—Sheets—
Blocks—Batts—Papers—Air-Cell
Write for your free copy of "Heat Insulation For Industry." Address your request to Dept. PO-7, The Philip Carey Manufacturing Company, Cincinnati 15, Ohio. In Canada: The Philip Carey Company, Ltd., 1557 MacKay Street, Montreal 25, P.Q.
Call your Carey representative today. He's a trained expert who is eager to serve you.
Carey

iate future in the U.S.? (3) What general policies of the coal industry would be indicated to best improve position of power and coal? An accompanying table shows the relative competitive position of bituminous coal, petroleum products, and natural gas as fuel. The author points out several places where there is no competition between the basic fuels. For instance, bituminous coal used for the manufacture of metallurgical coke, or kerosene for use as range oil in New England where it has displaced anthracite.

Coal's immediate future competition is (1) continued conversion of steam motive power to diesel operation (2) expansion of natural-gas pipelines (3) tendency for increased yield of fuel oil from domestic petroleum sources. The author then discusses in some detail dieselization of the transportation industry, expansion of natural-gas pipelines, and the possible future for fuel oil. As he sees it, coal stands to lose in the next five years 20,000,000 tons by dieselization, 80,000,000 tons to natural gas, 20,000,000 tons from additional sales of fuel oil. Coal consumption for fuel purposes only may well drop to within range of 210,000,000 to 230,000,000 tons annually before population increases or energy requirements per capita, or lowering of supply of competitive fuels changes this picture.

Future promise for coal seems to lie in the central-station field. Total consumption of bituminous coal by the electric-power utilities for electricity is now twice what it was in 1939, and over 40,000,000 tons more coal are being required yearly to meet this increase. The author feels the additional planned increase in generating capacity for the public utility industry will require an added coal tonnage because (1) supply of distillate fuel oil will increase faster than supply of residual oil and there will be no competition from this source (2) natural gas has not and probably will not be a serious competitor to coal in this field of use. *MWP paper. No number.*

FIRING FUELS

STANDARDS AND RULES, *by G T Kaufman, Oil-Heat Institute of America, Inc.* The oil-heat industry's condition with respect to standards is the paradoxical one of starvation in the midst of plenty. The industry itself has no standards; yet there are hundreds that cover its operation. These standards are in the form of codes, ordinances, regulations.

Few of these standards have anything whatever to do with quality or performance. Almost all are devoted to safety. Only four are concerned at all with quality or performance. These are

Synchronous Motors

DRIVE THE LOAD...

CORRECT THE POWER FACTOR

CLIP DOLLARS OFF POWER BILLS

If your need is for Big Motors and Controls, look to Electric Machinery . . . rely on its high degree of industrial specialization . . . its long experience and the uncommon competence in design and manufacture. Electric Machinery offers that type of extra value that gives users more for their money. E-M Synchronous Motors deliver extra value in these particulars.

Power Factor Improvements. Penalty payments for low power factor are eliminated or substantially reduced. **Power Savings.** Dollars clipped off power bills because E-M Synchronous Motors are highly efficient. **Drive Simplicity.** E-M Synchronous Motors, shaft-mounted on driven machines, eliminate belts and speed reducers. **Minimum Maintenance.** Coddling and hovering are unnecessary because of direct connection. All they require is occasional cleaning. **Constant Speed** is not affected by variations in load or voltage. This is an extra value for certain types of crushers and pumps. **Direct Drive** to the load . . . E-M Motors down to 72 rpm are profitable drives for compressors, pumps, grinders, pulverizers. **Riding through "Voltage Dips"**, thus avoiding shutdowns and processing blocks . . . you can rely on this with E-M Synchronous Motors. **Saving Space and Building Costs.** Trim, compact, direct-connected E-M Synchronous Motors do make these dollar savings. **P.S.** E-M field men, competent engineers, can give you case studies to demonstrate everything recorded above. They'd like to serve you. Get this written knowledge on your production team.

ADD THESE DATA BOOKS TO YOUR LIBRARY

Your selection of any or all of these Data Books will be sent you promptly. They're factual pieces with technical data precisely presented. Written by E-M engineers, they're a storehouse of useful information on Synchronous Motors.

☐ ABC OF SYNCHRONOUS MOTORS . . . A "tell-all" story . . . how synchronous motors are built, how they work, their application in industry.

☐ 8 PROFIT MAKING FEATURES OF SYNCHRONOUS MOTORS. Pictures and describes advantages of synchronous motors direct-connected to various types of drives.

☐ SELECTION AND APPLICATION OF SYNCHRONOUS MOTORS. Discusses application, power factor, excitation, starting, protection, maintenance.

☐ HOW TO CONTROL YOUR SYNCHRONOUS MOTOR. Discusses the control for starting and synchronizing these motors and explains the polarized field frequency system.

☐ POWER FACTOR AND WHAT TO DO ABOUT IT. A digest on power factor calculation, the need for correcting low power factor and how it can be done.

ELECTRIC MACHINERY MFG. COMPANY
1333 TYLER ST. N. E., MINNEAPOLIS, MINN.

● Please send me the literature as checked above.

Name_____

Title_____

Company_____

Address_____

City_____ State_____

1200-TPA-2092

E-M

SPECIALISTS IN

BIG MOTOR ENGINEERING

"GUNITE"
Concrete
(SINCE 1918)
Linings for
STEEL BUNKERS •
DUCTS, HOPPERS •
STACKS •
UPTAKES •
BREECHINGS •
• • •
STEEL & PIPE ENCASEMENT
• • •
FIREPROOFING •
GUNITE CONCRETE & CONST. CO.
1301 Woodswether Road
KANSAS CITY 6, MO.
R. N. Turner, Dist. Mgr., 228 No. La Salle St., Chicago 1, Ill. B. H. Mueller, Distr. Mgr., 8625 Delmar Blvd., University City, (St. Louis) Mo. Philip D. Barnard, Distr. Mgr., 2858 Addison, Houston 5, Tex.
Branch Offices: New Orleans, Dallas, Denver
"See our catalog in Sweet's"

Reprints Available:

REFRACTORIES

The practical handbook on refractory materials which appeared in the June issue of POWER is available in reprint form. Prices are: 25¢ for single copies, 21¢ for 100 or more, 19¢ for 500 to 1,000.

Address your order to:

Editorial Dept.

POWER

330 W. 42nd St., New York 18, N. Y.

the Commercial Standards of the National Bureau of Standards.

By having no good standards of their own making and allowing others to draft and promulgate standards, the oil-heat industry leaves itself open to distortion and misinterpretation by outsiders. Some standards discriminate against makes or types of burners.

Certain cities require that oil burners be installed by only one group or certain groups of people licensed by the city.

Some standards discriminate against oil in favor of another fuel. Building Code recommended by the National Board of Fire Underwriters contains requirements on chimneys, flues, vents for gas-burning appliances different from those for coal or oil.

The author feels the oil-heat industry should draft its own set of standards and make them nationwide in application. Then it should go after the hundreds of confusing and conflicting local standards and get them to conform to the national standards. *OHI paper. No number.*

DISTRICT HEATING

STEAM SERVICE FROM CENTRAL STATIONS, *by G D Winans, Detroit Edison Co.* District heating in many communities is considered a form of public-utility service. The practice on a large scale had its beginnings about the start of this century. It was a natural development of the engineer's desire to put all available energy to work. The waste exhaust from the steam engine of that day seemed attractive as a district-heating medium.

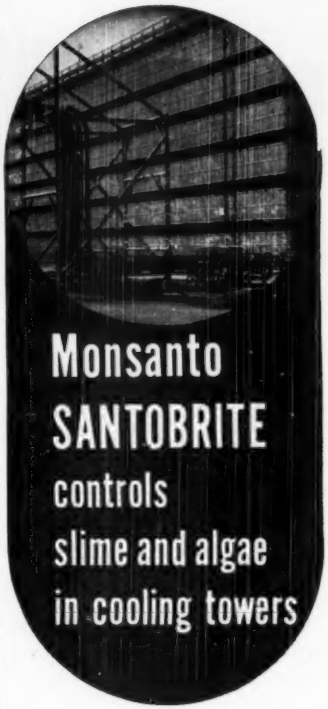
Once the condensing plant came into being waste heat from the electric-generating plant almost disappeared. Many district-heating plants had to supply live steam from boilers to carry their heating loads. The customer had been educated to a cost based on a waste product. As a result many district-heating companies experienced unprofitable seasons.

Of recent years the service rendered and its value have been recognized and appreciated. Further, many business and office buildings find the space-saving features highly desirable, often a direct income producer.

Some industries have gone to district-heating companies for process as well as space-heating needs. Developments at Rochester, N.Y. and Indianapolis are particularly significant.

The author discusses the problems of the industry. Subjects covered are design, operation, application, economics, and something of the possible future. *MWP paper. No number.*

(*Continued on page* 220)



Monsanto SANTOBRITE controls slime and algae in cooling towers

Slime and algae, enemies of good cooling tower operation, are kept under control by Santobrite (Monsanto's sodium pentachlorophenate, technical). Santobrite is economical...easy to use...efficient.

If slime and algae cause trouble in your cooling towers, it will pay you to read Monsanto Technical Bulletin No. O-15. For your copy, contact the nearest Monsanto Sales Office or write: MONSANTO CHEMICAL COMPANY, Desk A, 1763 South Second Street, St. Louis 4, Missouri.

Santobrite: Reg. U. S. Pat. Off.

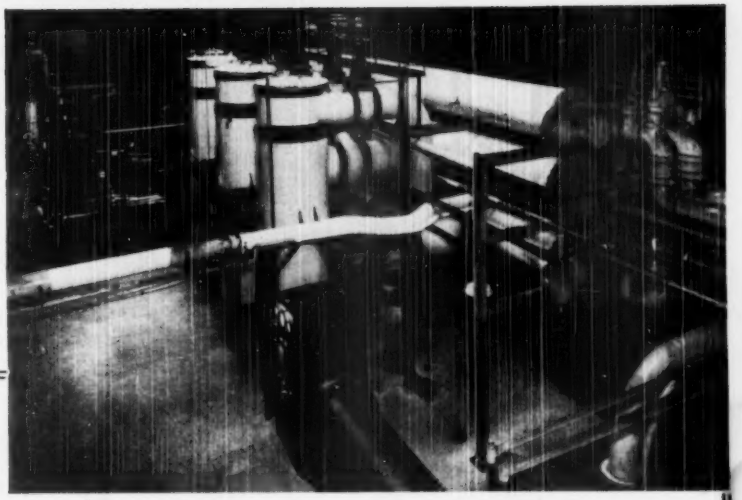
DISTRICT SALES OFFICES: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto (Canada) Ltd., Montreal.

MONSANTO
CHEMICALS — PLASTICS

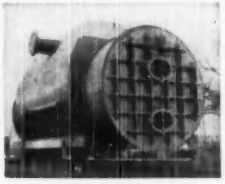
SERVING INDUSTRY... WHICH SERVES MANKIND

Three CONSECO CONVERTERS

handle hot water heating needs for large mid-western industrial plant

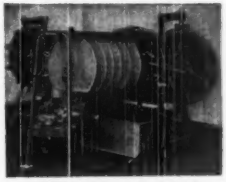


CLOSED HEATERS



CONDENSERS

DEAERATORS



REFINER FILTERS

Each of the three units shown handles 5330 gallons of water per minute, heating it from 175° to 195°F. The hot water heating system, of which these CONSECO units are an essential part, is installed in the Chicago plant of a leading electrical equipment manufacturer.

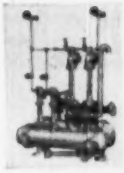
In the converters shown, water is heated with steam at 1 PSI G. Each unit has 3140 sq. ft. of heating surface in a 47" shell. Units are of the internal floating head, removable bundle type with a deep shell cover that serves as a storage section, and when removed, allows inspection and maintenance of the floating head.

The water boxes are fitted with separate covers so that cleaning of the tubes can be accomplished without breaking any pipe connections.

CONSECO engineers are specialists in heat exchanger equipment and are available to assist you in designing units to meet your specific requirements. CONSECO production facilities are modern, complete and efficient and make possible worthwhile savings in building equipment to your specifications.

Write for Engineering Bulletins on CONSECO Power Plant and Processing Equipment.

STEAM CONDENSERS and STEAM JET AIR EJECTORS . . . designed, built and erected



STEAM JET AIR EJECTORS

BOILERS

EVAPORATORS

CONSECO **Condenser Service & Engineering Co.**
HOBOKEN, N. J.

POWERS No. 11 Self-Acting REGULATORS

now give you **MORE** for your money

OVER-HEAT PROTECTION

Temperature Adjustment has bronze OILITE thrust bearing

VALVE STEM LUBRICATOR

TEMPERATURE ADJUSTMENT 60° F. ranges available

UNSURPASSED FOR DEPENDABILITY and LONG LIFE

Lower Maintenance Cost and—

BETTER

CONTROLS HEATING OR COOLING MEDIUMS LIQUIDS OR AIR

TEMPERATURE CONTROL

SIMPLIFY your temperature control problems by standardizing on POWERS No. 11 Self-acting Regulators. Use them when you want a simple rugged control to maintain a constant temperature. They prevent OVER-heating, save fuel and labor, pay back their cost several times a year and give years of dependable control.

Backed by over 55 years of experience in self-acting regulators. Engineering service available in over 50 cities.

No. 11 INDICATING REGULATOR has 4" dial mounted on top of regulator. Both thermometer and regulator operate from same thermal system. Visual check on performance of regulator is provided making it easy to adjust for different temperatures. (1185)

TYPES AVAILABLE—Direct and reverse acting regulators with Double Seat balanced valve, double unions ½ to 2" incl., flanged 2½ to 6" incl.; Single Seat valve double unions ¼ to 1¼" incl. 3-Way valve ½ to 4" incl. —shown in Bulletin 329. **Use coupon below**

THE POWERS REGULATOR CO., 2771 Greenview Ave., Chicago 14, Ill.

Gentlemen: Please send me Bulletin 329. Am interested in control for

Name _____ Title _____

Firm Name _____

Address _____

TURBINE OPERATION

LATEST TECHNIQUES FOR QUICK STARTS ON LARGE TURBINES AND BOILERS, *by J C Falkner, D W Napier, C W Kellstedt, Consolidated Edison Co of New York, Inc.* It has been calculated that if quick starting could be reduced to 15 minutes or less on all topping and condensing machines on the Consolidated Edison system, an annual saving of $250,000 would result. This saving comes from auxiliary power, stack and river losses, fuel fed to the furnaces.

There are many practical advantages over and above the operating savings. On August 27, 1948, the Manhattan Cooper Square network was deenergized because the generator cables in Waterside No. 2 failed. This caused a simultaneous outage of three out of four topping units in this station. Just as soon as the cables on No. 4 were temporarily repaired this machine was brought up to speed and was generating power in less than 15 min. This allowed the network to be reenergized. If the original 3-hr start had been in vogue, the network would have stayed out of service for at least 2½ hr more.

On April 18, 1949, with simultaneous forced outages of two topping units at Sherman Creek, No. 9 unit went back into service in 22 min after an 11-hr shutdown. It is eventually hoped to arrive at 5-min startups.

The authors discuss procedure for such quick starts. In addition results of such starts on some of the turbines are revealed. Results of a number of tests run by the company, shown in graph form, are discussed. *ASME paper No.* 50-S-1. 29 W 39th St, New York 18.

REFRIGERATION

DEVELOPMENT OF TURBINE-DRIVEN REFRIGERATION AND WATER ABSORPTION REFRIGERATION MACHINE, *by O E Gammill, Jr, Carrier Corp.* This paper deals with refrigerating units from about 100 hp up to 3000, using heat as the motivating element instead of electric power.

About 80% of the large centrifugal installations are driven by electric motors. But there are cases where the heat-driven unit would be preferred to the motor-driven because of cheaper owning and operating costs. Such applications are used where (1) fuel is cheap and control automatic, as with gas in the Southwest (2) public utility sells steam as a byproduct (3) equipment fits onto a heat balance.

Today more refrigeration is being installed for air conditioning and industrial processes than for any other use so the above factors have some significance in such a market.

The author discusses two refrigeration machines—the steam-turbine cen-

In all the world there's only one TUBE-TURN Welding Fitting as shown by this trade mark... the right mark for every need in welding fittings and flanges.

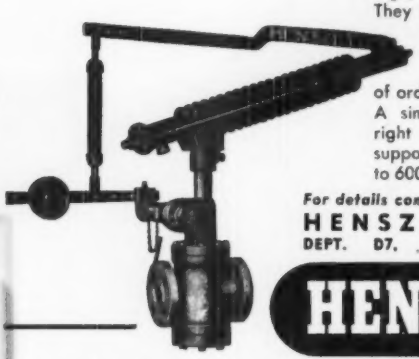
Your nearby TUBE TURNS distributor can serve you right from stock. Call him for prompt delivery.

TUBE TURNS, INC., LOUISVILLE 1, KENTUCKY DISTRIBUTORS IN ALL PRINCIPAL CITIES

DISTRICT OFFICES: NEW YORK • PHILADELPHIA • PITTSBURGH • CHICAGO • HOUSTON • TULSA • SAN FRANCISCO • LOS ANGELES

In Canada . . . Tube Turns of Canada Limited, Chatham, Ontario

HENSZEY *Boiler Feed* REGULATOR
***Keeps a* WATCHFUL EYE *on* BOILER WATER LEVELS**
• CONTINUOUSLY • AUTOMATICALLY • ACCURATELY
***under* ALL LOAD CONDITIONS**



They help avoid the hazards of high, as well as low, water levels. They function night and day—once installed and set for operation no attention is necessary — nothing to get out of order — nothing to rust.
A simple, compact unit — installs right in the line — no additional supports are necessary. Pressures up to 600 lbs., sizes up to 4 in.

For details consult Sweet's Catalog or write:
HENSZEY COMPANY
DEPT. D7, WATERTOWN, WISCONSIN

HENSZEY

BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

Above: Sauerman Power Scraper System stores and reclaims coal at a rate of 300 tons per hour. Sitting in a room above the receiving hopper, the operator sees every move of the machine and guides every move through simple automatic controls.

***With the* SAUERMAN**
One-Man Scraper System

Storage of any desired tonnage of coal is an easy, comfortable one-man job with a Sauerman Power Drag Scraper. This equipment makes full use of any ground space with little advance preparation. It stacks the coal in compact layers, so there are no air pockets to encourage spontaneous combustion. Everything about the equipment is simple and it gives continuous satisfaction with a minimum of attention. Hundreds of operators report that their Sauerman machines are as good as new after many years of service with annual repair costs running as low as one-half cent per ton handled.

Write for illustrated engineering catalog.
SAUERMAN BROS., INC.
562 S. CLINTON ST. CHICAGO 7, ILLINOIS

trifugal refrigeration unit and the water-absorption design. Both, of course, operate as heat-driven units. The various elements in the refrigeration cycle of each are covered, as well as some of the advantages. *MWP paper. No number.*

For paper sources, see page 140.

BOOKLETS

PIPE-FITTING CATALOGUE AND ENGINEERING DATA BOOK NO. 211. 262 *pp*, 9x11, *Tube Turns, Inc, Louisville* 1, *Ky. Distribution is restricted to major users, designers and erectors of industrial piping. When requesting a copy, use company letterhead and give details about your position.*

Catalog contains description and price lists of all types of welding pipe fittings, showing different methods of welding.

Sixty pages are filled with engineering data on properties of pipe, rating of pipe and flanges, line expansion and flexibility, support and anchorage of piping and flow of fluids.

Considerable research, calculations and experiment were required to prepare the technical section covering piping design. It will be of real value as a guide to piping engineers.

WATER RESOURCES PAPER 100 (1949). *By Dominion Hydrometric Survey, 69 pp, 6¼x9¾, tables, stiff paper.* 50c. *Dominion Water and Power Bureau, Dept of Mines and Resources of Canada, Ottawa, Ont.*

Gives results of a study made by Dominion Hydrometric Survey during the climatic years of 1945 and 1946, in New Brunswick and Nova Scotia. This volume contains stream-flow data for rivers within the area mentioned, together with rainfall records at a number of places in the two provinces.

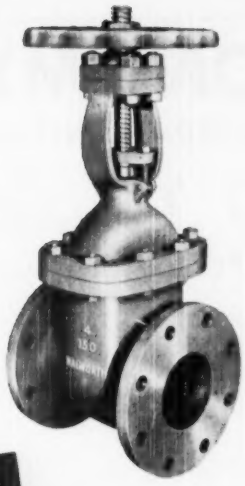
SAFETY CODE FOR MANLIFTS (1949). *Sponsored by Assn of Casualty and Surety Cos and American Society of Mechanical Engineers. 22 pp, 5¼x7¾, stiff paper.* 55c. *ASME, 29 W 39th St, New York* 18, *N. Y.*

Manlifts as covered by this code consist of platforms or brackets mounted on or attached to an endless belt, cables or chains, operating in a vertical direction and supported by and driven through pulleys, sheaves or sprockets. They are intended to convey persons only. The code applies to their construction, maintenance, operation, and endeavors to eliminate accident hazards. It does not cover moving stairways, elevators with enclosed platforms, gravity lifts or conveyors used only for materials handling.

WATER RESOURCES PAPER NO. 95 (1949). *By Dominion Hydrometric Survey. 498 pp, tables, 6¼x9¾, stiff paper.* $1. *Dominion Water and Power Bureau, Dept of Mines and Resources of Canada, Ottawa, Ont.*

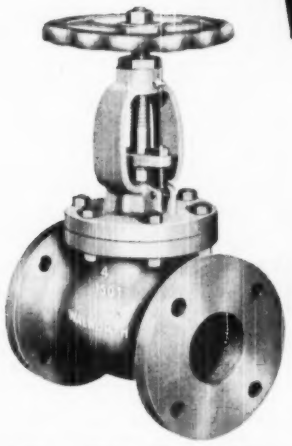
This is Vol 95 of water-resources papers dealing with surface-water supply of Canada. It contains the results of studies made by the Dominion Hydrometric Survey during the climatic years 1943 to 1945 inclu-

Newly Designed Walworth Valves to combat corrosion



Walworth 150-pound Stainless Steel Gate Valve . . . available in sizes ½ to 3-inch, screwed; ½ to 12-inch, flanged.

Made of Stainless Steel
Monel · Nickel
Acid-resisting Bronze
Ni-resist



Walworth 150-pound Stainless Steel Globe Valve . . . available in sizes ½ to 3-inch, screwed; ½ to 6-inch, flanged.

Sectional view of Walworth 300-pound Stainless Steel Gate Valve . . . available in sizes 2 to 6-inch, flanged.

— ENGINEERED AND TESTED FOR TOUGH . . . HARD SERVICE

Walworth offers a comprehensive line of valves made of several cast stainless steels and special alloys for piping services where corrosion is a factor. These valves are available in Gate, Globe, Angle, Check, and Lubricated Plug types.

Gate, Globe and Angle Valves have outside screw and yoke construction, thus keeping the stem threads out of contact with the corrosive material in the line. They also have a two-piece bolted gland with ball-type gland follower to prevent binding the stem when packing bolts are tightened. Gland eye-bolts can be conveniently swung out of the way without danger of loss when the gland is lifted for repacking.

Gate Valves have taper seats with a unit consisting of two flat faced discs supported by a carrier on the end of the stem. The discs are of a proven ball-and-socket type. They are free to rotate and adjust themselves to the body seat angles, assuring tight seating with no possibility of sticking in any position.

For further information about Walworth's full line of corrosion-resistant valves, see your Walworth distributor.

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

ECONOMY

AT MODERATE INITIAL COST

100 TO 4000

HORSEPOWER RANGE

600# GA., 750° F.

STEAM PRESSURES

MURRAY

STEAM TURBINES

TYPE UV MULTISTAGE

The Type UV Multistage Turbine is available in from two to ten pressure stages making Multistage steam economy available at moderate initial cost. Horsepower range is from 100 to 4000, steam pressures up to 600# ga., 750° F., condensing or non-condensing. Several governors and accessories adapt UV Turbines to practically any mechanical drive within the capacity range.

Pictured is a 5 Stage UV Turbine developing 325 HP at 6200 RPM operating condensing. Turbine is equipped with variable speed oil relay governor, pressure lubrication and vacuum breaker, and is in use driving a centrifugal compressor for refrigeration.

Contact your Murray representative for prices and engineering information or write for Bulletin T-122.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

sive, in Ontario and Quebec. Chief material is 470 pages of stream-flow data for the principal rivers and streams in the two provinces. The hydrometric data include, for most stations, the mean monthly discharge during years of record.

ENGINEERING PAPERS OF HYDRAULIC INSTITUTE, *Vol* II, 61 *pp*, 8½x11, *paper*, $2. *Hydraulic Institute, 90 West St, New York 6, N.Y.*

This volume contains winning papers in various engineering contests sponsored by Hydraulic Institute for the employes of its members as follows:

(1) *Cavitation in Centrifugal Pumps*, by A J Stepanoff (2) *The Centrifugal Pump in the Process Industries*, by A T Nielsen (3) *The Operation of Centrifugal Boiler Feed Pumps*, by Hans Gartman (4) *Submergence for Centrifugal Condensate Pumps* by Hollis T Waldo.

A DICTIONARY OF ELECTRONIC TERMS (1950). *Edited by Harry L Van Velzer, associate professor of electrical engineering, Univ of Illinois, 64 pp, 6x9, 125 illust, stiff paper, 25c. Allied Radio Corp, 833 W Jackson Blvd, Chicago 7, Ill.*

This book, with definitions of over 2500 terms in television, radio and industrial electronics, fills the need for an accurate reference source of words used in a rapidly expanding electronics field. Definitions cover mostly modern techniques and equipment, but range from many words no longer generally used to the new language of color television and electronics of nuclear physics. Many illustrations of parts, equipment, circuits add much to the book's value.

SIMPLIFIED PRACTICE RECOMMENDATION FOR WIRE ROPE, 193-43. *National Bureau of Standards, 21 pp, 6x9, paper, 10c. Sup't of Documents U.S. Government Printing Office, Washington 25, D. C.*

This revised recommendation contains 21 tables that cover wire-rope constructions representing a large part of the tonnage produced for stock purposes. Tables give rope sizes, weights per foot, breaking strengths for different grades and construction. Inconsistencies or inaccuracies on breaking strength that may have existed in the past are corrected here. Tables do not, however, cover the duties a particular rope is suited for. This is best left to the rope manufacturer, who can make recommendations and stay within the *Simplified Practice* requirements.

WATER RESOURCES PAPER NO. 98. *329 pp, 6½x9¾, stiff paper, $1. Receiver General of Canada to the Chief, Water Resources Div, Ottawa, Ont., Canada.*

Here are results of studies by Dominion Hydrometric Survey of stream-flow in Pacific drainage area in Province of British Columbia and Yukon Territory from Oct 1942 to Sept 1944. Included are short explanation of the organization, the work done, and 314 pages of stream-flow data, together with mean temperatures and precipitation for these two years at a number of places in the area. Report applies to Columbia, Fraser, Kootenay, Skeena, Thompson, Yukon and other rivers.

Too good to miss

Of course Kinney Rotary Vacuum Pumps are too big to fit on a desk top, but they sure fit naturally into the modern steam generating station. With throttle conditions in the 1000 psi — 1000°F. class, these mechanical vacuum pumps provide economies for condenser vacuum control that are truly too good to miss:

Pumping efficiency that's too good to miss: Kinney Rotary Vacuum Pumps are equally efficient at starting and regular running conditions — from atmospheric pressure down to a fraction of an inch Hg. abs.

Manpower economies that are too good to miss: Kinney Rotary Vacuum Pumps are controlled at the central control panel. No longer is it necessary to play watchdog to troublesome reducing valves and "hogging jets" scattered throughout the plant.

Rugged dependability that's too good to miss: Kinney Pumps are designed for continuous operation. There's no scrubbing action within the pump. The Kinney Pump has an oil-sealed, non-wearing pumping mechanism.

Contaminant removal that's too good to miss: Carbon dioxide, ammonia, and other corrosive gases are removed along with the air-vapor mixture by the Kinney Mechanical Vacuum Pump — no tendency to concentrate these contaminants as with steam-jet ejectors.

Simpler piping layout that's too good to miss: Kinney Rotary Vacuum Pumps eliminate costly high-pressure pipelines to auxiliary equipment . . . permit the ideal piping layout: a single steam line from boiler to turbine.

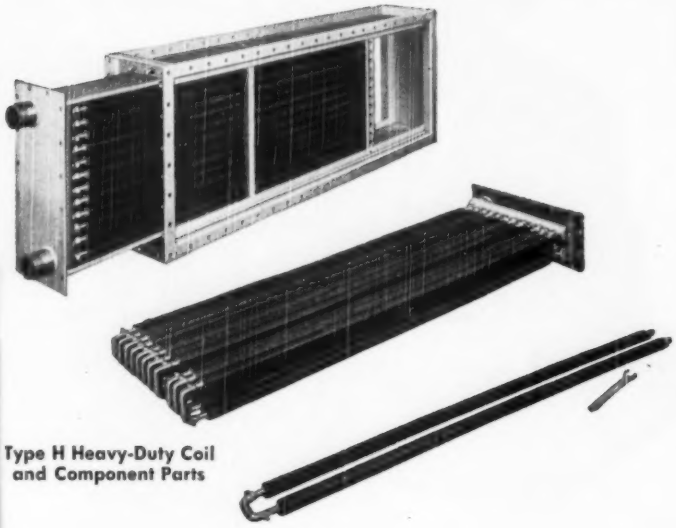
Kinney Engineers are ready to help you obtain these economies in your power plant. Send for "Use of Mechanical Vacuum Pumps in Central Station Operation" — a detailed engineering report including installation diagrams. Also Kinney Bulletin V45, the full story on Kinney Rotary Vacuum Pumps.

Kinney Manufacturing Company, 3532 Washington St., Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Houston, New Orleans, Philadelphia, Los Angeles, San Francisco, Seattle.

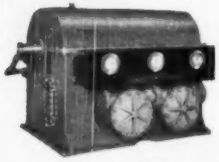
Foreign Representatives: General Engineering Co. (Radcliffe) Ltd., Station Works, Bury Road, Radcliffe, Lancashire, England . . . Horrocks, Roxburgh Pty., Ltd., Melbourne, C. I. Australia . . . W. S. Thomas & Taylor Pty., Ltd., Johannesburg, Union of South Africa . . . Novelectric, Ltd., Zurich, Switzerland . . . C.I.R.E., Piazza Cavour 25, Rome, Italy.

KINNEY
Vacuum Pumps

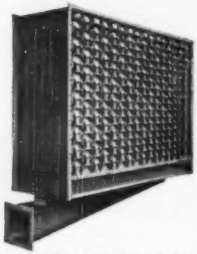
AMERICAN BLOWER HEAVY DUTY STEAM COILS
a really profitable investment!



Type H Heavy-Duty Coil and Component Parts

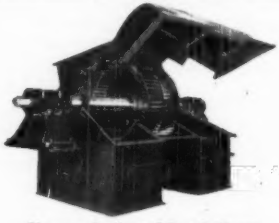


Gyrol Fluid Drives for Boiler Feed Pumps

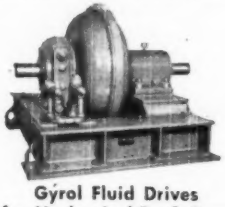


Type ST Fly Ash Precipitators

American HS Forced Draft Fans



Sirocco Induced Draft Fans



Gyrol Fluid Drives for Mechanical Draft Fans

We're certain you'll find American Blower Type H Heavy-Duty Steam Coils a sound and profitable investment—especially if you consider them in terms of these three important advantages:

1. **American Blower** Type H Heavy-Duty Coils are designed, tested and guaranteed for operation with steam at 350 lbs. gauge pressure and 600° F. temperature.
2. **Type H Coils** contain cupro-nickel tubes which provide extra corrosion resistance.
3. **The entire** heating element is removable from the casing and can be completely dismantled for inspection, maintenance and repair. Individual tubes are replaceable. Casing is heavy steel, welded airtight.

For detailed information on American Blower Type H Coils, write for our Bulletin B-1318, or call our nearest branch office for a copy.

And if you'd like complete data on other American Blower power plant equipment—Mechanical Draft Fans, Fly Ash Precipitators and Gyrol Fluid Drives for boiler feed pumps and fan control—merely write, stating your requirements, or phone the nearest American Blower Branch Office.

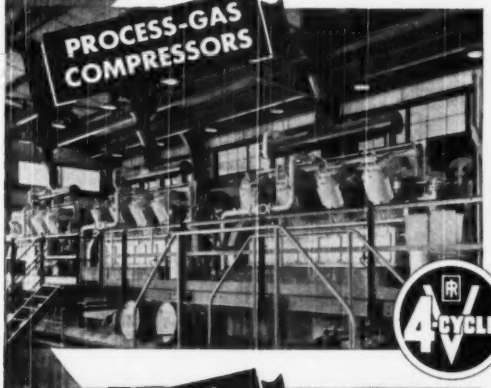
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

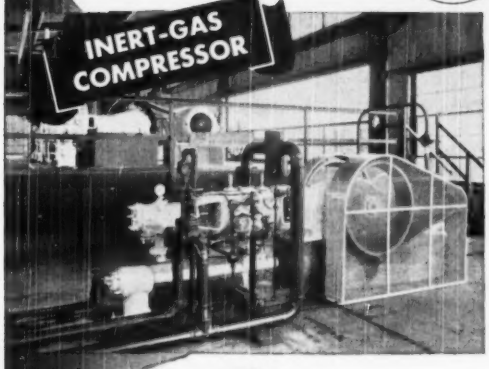
YOUR BEST BUY AMERICAN BLOWER POWER PLANT EQUIPMENT

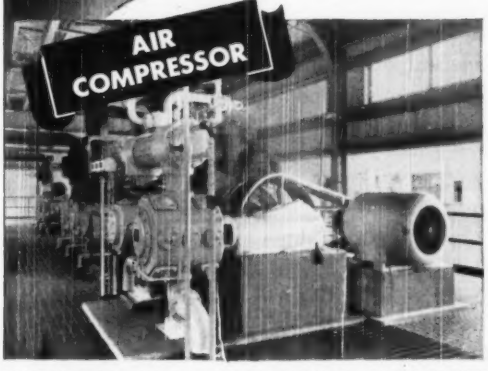
Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

Compressors HELP PRODUCE HYDROGEN CYANIDE at new ROHM & HAAS plant







At its Deer Park Chemical Plant in Texas, the Rohm & Haas Company produces hydrogen cyanide on a large scale from ammonia, air, and natural gas as raw materials. The chemical products of Deer Park are shipped to other plants for making Plexiglas sheet plastics, coatings for leather, finishes for textiles, and adhesives.

In this Hypersorption process demanding the maximum in dependability, safety, and flexibility of control there are several types of Ingersoll-Rand compressors and four large I-R circulating pumps.

PROCESS-GAS COMPRESSORS...300-hp gas-engine-driven compressors handle the process gas from a regenerating unit. These are of Ingersoll-Rand 4-cycle, V-angle design, famous for economy of operation and maintenance, reliability, and flexibility for loading and control. (This type of I-R compressor is available in sizes from 100 to 1320 hp).

INERT-GAS COMPRESSOR...This 50-hp belt-driven, two-stage, ES heavy-duty unit compresses an inert gas to 200 psig pressure. The gas is held in storage as a safety measure in case of leakage of the chemical products, and for purging of lines.

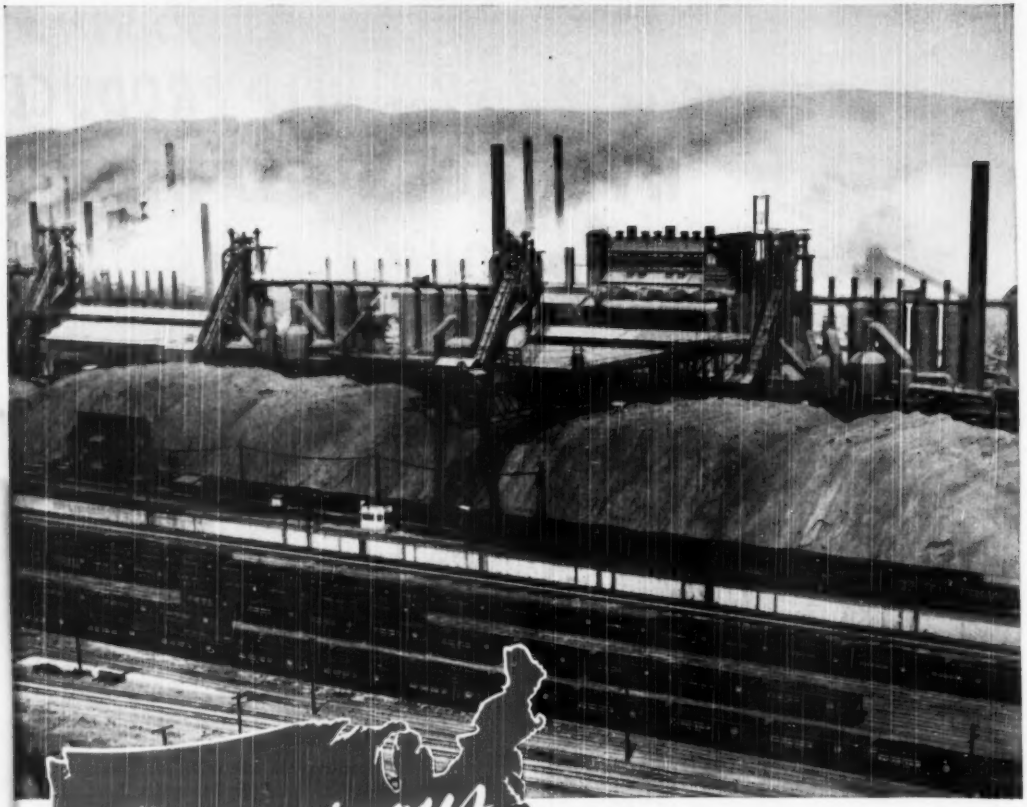
AIR COMPRESSOR... This 125-hp, 2-stage, belt-driven Type XCB compressor generates 100-psig Air Power for instrument control and miscellaneous uses around the plant.

Call on Ingersoll-Rand when you need compressors for chemical or petroleum processes. There is a complete line of sizes and types for every purpose, and a representative near you.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 479-1

COMPRESSORS · AIR TOOLS · ROCK DRILLS · TURBO BLOWERS · CONDENSERS · CENTRIFUGAL PUMPS · OIL AND GAS ENGINES



Bituminous is indispensable to the power of America

The bituminous coal industry
has the strength—the know-how—
to meet *any* challenge.

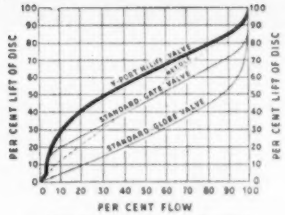
Only with indispensable bituminous
can the greatness of America be maintained.

For excellent bituminous coals
to meet your every need,
Ask our man!

BALTIMORE & OHIO RAILROAD

Constantly *doing things* **—better!**

LINKING 13 GREAT STATES WITH THE NATION
B&O


PER CENT LIFT OF DISC
PER CENT FLOW
V-PORT HI-LIFT VALVE
PARABOLIC DISC VALVE
STANDARD GLOBE VALVE
0 10 20 30 40 50 60 70 80 90 100

Flow characteristics of the Honeywell Hi-Lift Hand Control Valve far surpass those of conventional designs . . . offer favorable comparison to the precision of such diaphragm operated control valves as the Honeywell Series 700.

WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL
COMMERCIAL · RESIDENTIAL · INDUSTRIAL

THE Honeywell Hi-Lift Hand Control Valve is ideal for use where automatic regulation is not necessary or advisable. Designed to afford micrometer adjustment of flow, it contains an indicating scale to show percentage of stem travel to 1% and an inner valve capable of responding to such close correction. Inset illustration shows the simple and easy-to-read scale and the curve at left portrays the superior flow characteristics of the Hi-Lift over conventional valve designs.

The Honeywell Hi-Lift is available with v-port or parabolic discs . . . in sizes from ¼" to 12" . . . straight through or angle . . . for pressures up to 600 lbs. . . . with body of Bronze, High-Tensile Iron or Cast Steel . . . and with Bronze or Stainless Steel trim. Available, too, with electric motor for remote control applications.

Call in your local Honeywell engineer for detailed information about the Hi-Lift and such other Honeywell Process Control Specialties as: Transfer Valves, Liquid Level Devices, Cylindrical Plug Valves and the Honeywell Space-Saving Bypass. *Write, today, for a copy of Bulletin #242-1!*

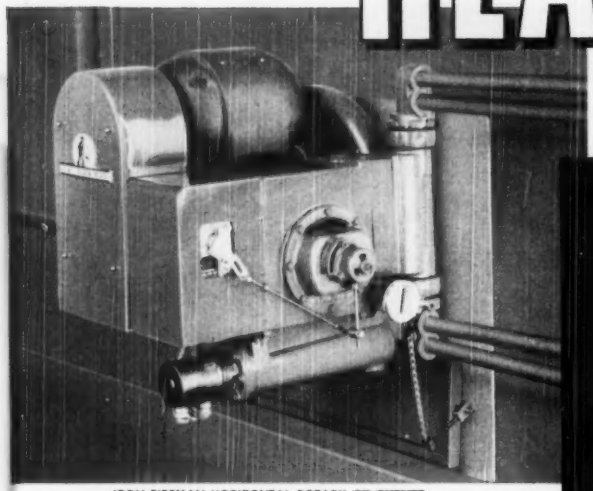
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 1900 Windrim Avenue, Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

Honeywell
VALVE PRODUCTS

IRON FIREMAN

precision firing with HEAVY OIL

NO. 6 OR LIGHTER



IRON FIREMAN HORIZONTAL ROTARY OIL BURNER

Oil feed rate stays within ½ of 1% of setting, regardless of oil temperature or viscosity

America's most advanced burner for firing heavy fuel oil

The Iron Fireman horizontal rotary oil burner completely eliminates the troublesome viscosity factor in firing heavy oils. Oil-flow to nozzle is steady and uniform, metered with extreme accuracy by the Iron Fireman Oil Volumeter which is wholly unaffected by viscosity changes.

This makes possible the highest degree of precision in flame control attained in heavy oil firing. Perfect synchronization of oil and air volume produces efficient combustion, even when throttled down to 10 per cent of capacity.

Every detail of this superb burner has been engineered with extreme care. Oil and air passages have been carefully designed to assure efficient operation with low power consumption.

For further information write to Iron Fireman Mfg. Co., 3235 W. 106th St., Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada. Qualified dealers throughout the U. S. and Canada.

IRON FIREMAN OIL VOLUMETER

The Iron Fireman Oil Volumeter is a positive displacement, variable volume metering pump, completely submerged in the oil reservoir. It meters oil to the nozzle by regulating the stroke of its multiple pistons. No regulating valves or viscosity compensating device is required.

SYNCHRONIZED OIL-AIR CONTROL

Single control lever regulates oil, primary and secondary air. Correct fuel-air ratio maintained automatically through entire firing range. For manual, semi-automatic or full automatic operation.

FOUR-PORT HINGE POST

Permits installation of hot water or steam oil heater in oil line on *pressure* side of burner pump. No suction pumping of hot oil to form vapor locks.

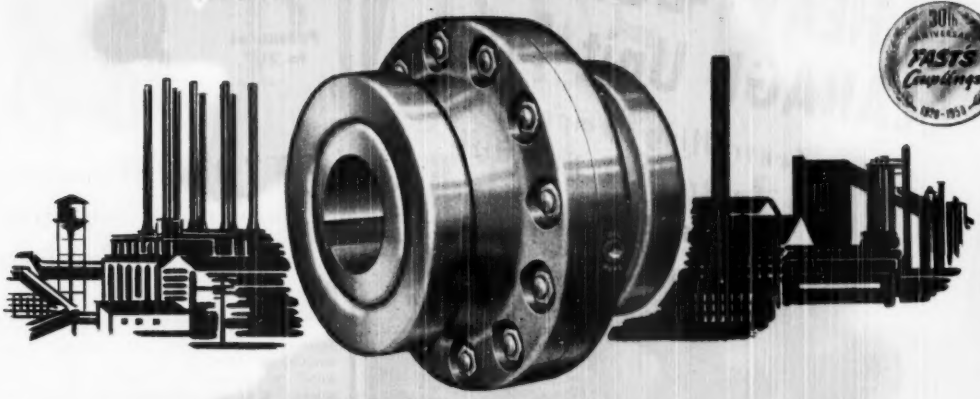
OIL-GAS-COAL COMBINATION

Iron Fireman ring-type gas burner and pneumatic spreader stoker combine perfectly with rotary oil burner. Fuel change is accomplished in a short time without major alterations. Protects your plant against high fuel prices or shortages. Impartial Iron Fireman survey will help you determine which fuels are best fitted for your operation.

IRON FIREMAN

AUTOMATIC FIRING EQUIPMENT FOR OIL GAS COAL

you can FORGET COUPLING SHUTDOWNS—



INDUSTRY REPORTS—

KOPPERS ENGINEERING STOPS COSTLY FAILURES

These FAST'S COUPLING *Services save you money!*

UNSURPASSED ENGINEERING . . . *Koppers Engineers are acknowledged the best in the coupling industry. Their practical knowledge, backed by 30 years of coupling experience, is at your service!*

IMMEDIATE DELIVERY . . . *All standard types and sizes are available for immediate delivery from "on hand" stocks. In case of emergency, just wire factory for special rush delivery!*

LOWEST COST PER YEAR . . . *Fast's Couplings will outlast equipment they connect if properly maintained. Their cost may be spread out over 25 years or more, offering you lowest coupling cost per year!*

In oil fields, steel mills, power plants . . . all through industry . . . cost-wise executives report that *Fast's Couplings*, designed, manufactured and guaranteed by Koppers, are the best insurance against coupling failures! Take a tip from these users who know. Specify Fast's and forget *your* coupling problems!

By specifying Fast's, you get the benefit of Koppers Engineering Service, acknowledged best in the industry. Koppers Engineers, backed by 30 years coupling experience, study your problem . . . then show you *which* Fast's Coupling fits your application, (and more important) *why* you need it!

Only Koppers can offer you this valuable service . . . only Koppers offers Fast's, the original gear-type coupling. Fast's Couplings assure you freedom from expensive coupling failures in your plant because Fast's have no perishable parts to fail!

GET THE FACTS: Mail coupon today for your free copy of the Fast's Coupling Catalog, published by Koppers. Shows how Fast's operate, describes the many sizes and types. Gives full details about Koppers Engineering Service. Send for your copy today.

KOPPERS **FAST'S**

THE ORIGINAL GEAR-TYPE **Couplings**

FREE CATALOG

KOPPERS CO., INC., *Fast's Coupling Dept.*,
227 Scott Street, Baltimore 3, Md.

Please send me a free copy of your Fast's Coupling Catalog.

Name.....Title.....

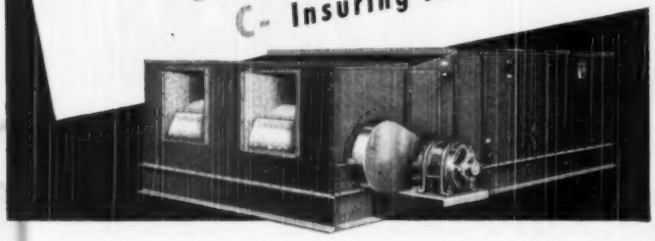
Company.....

Address.....

City.....Zone.....State.....

One HEAVY-DUTY CLARAGE Unit for:

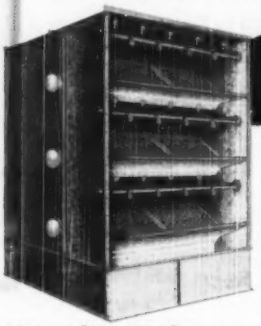
A- Controlling Temperature
B- Controlling Humidity
C- Insuring Air Cleanliness



Use Clarage Capillary Air Conditioners where *maximum air cleanliness plus accurate control of temperature and humidity* are vital to production, uniformity of product, health or safety.

These Capillary Conditioners are completely assembled units, including a capillary cleaning section, pump, heating coils, fans, drive and motor. Built in seven sizes — 1,800 to 20,000 cubic feet of air per minute, either vertical or horizontal units.

There are excellent reasons for preferring this modern equipment: (1) *Inexpensive to install* — no costly building alterations required; (2) *Everything in one "package"* — no parts to assemble; (3) *Proper performance* assured by factory tests; (4) *Low first and operating costs* — the result of shrewd, advanced engineering.



CAPILLARY AIR WASHERS
4,400 to 132,000 CFM

Clarage Capillary Air Washers are widely used where you need air cleanliness only (temperature and humidity control not desired), or they may serve as the cleaning units in complete air conditioning central systems. Built in 5 height and 11 width sizes.

All Clarage equipment is HEAVY-DUTY; *fully equal to severest industrial requirements.*

We Also Make: Complete Line of Industrial Fans . . . Unit Heaters . . . Air Conditioning Equipment . . . Mechanical Draft Apparatus

CLARAGE FAN COMPANY – *Kalamazoo, Michigan*

CLARAGE
—HEADQUARTERS for Air Handling and Conditioning Equipment

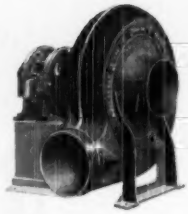
SEE OUR CATALOG IN SWEET'S

It pays to direct fan inquiries our way . . . phone Clarage office in your city, or write us at Kalamazoo.

Application Engineering Offices in All Principal Cities

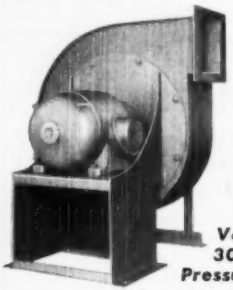
Capacities to 4000 CFM

Pressures to 20"



THREE Economy Answers to Industrial Air Handling Problems

1 **TYPE CI EXHAUSTERS** are built to the *same exacting standards* as the largest Clarage equipment; *heavy-duty* in every sense of the word! Widely used for removing excess heat, smoke, odors from manufacturing operations . . . in pneumatic conveying . . . supplying air to oil burners, as over-fire fans, etc. Regularly furnished with corrosion-resisting cast iron housings, or in any special construction your special needs demand.

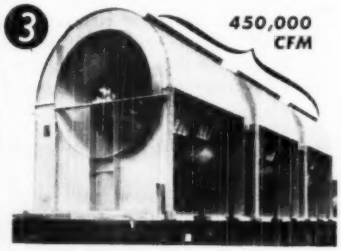


2 **Type O Blowers**

Volumes to 30,000 CFM
Pressures to 35"

For *higher pressure*, larger capacity applications . . . supplying air to cupolas, industrial gas and oil burners, etc. Fan housings and wheels of heavy steel plate "take in stride" toughest operating conditions. Clarage Type O blowers are built in 19 sizes; operate at speeds *most economical* for direct motor or turbine drive.

3 **450,000 CFM**

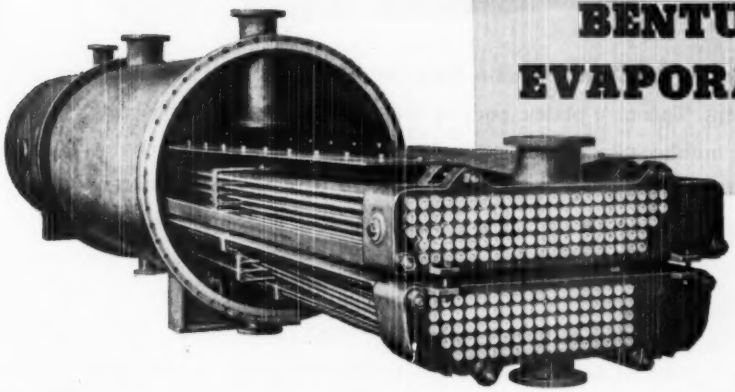


CLARAGE BUILDS equipment *big enough for ANY air handling requirement.* Example: these three Type W Fans recently shipped to a steel plant, and now installed in a large building where gas engines generate electricity. They dilute escaping toxic gas fumes, thus providing safe air for workers. Each fan delivers 150,000 cubic feet of air per minute; must operate continuously. Their *heavy-duty* qualities insure uninterrupted service on this essential job.

CLARAGE FAN COMPANY, Kalamazoo, Mich.

PUREST Make-Up Water

from the ..... **G-R BENTUBE EVAPORATOR**



NO MATTER what the kind or amount of impurities in your feedwater supply, you can count on getting pure distilled boiler feed make-up from a G-R Bentube Evaporator. This make-up water is, in fact, *purer than that obtainable by any other method.* Its hardness is as low as one part per million. Silica content can be reduced to one-tenth part per million.

You can be sure, too, that a G-R Bentube Evaporator will maintain rated capacity throughout its long life. That's because of the patented design of the G-R Bentube elements, which are set with a slight initial curvature into the cast headers. *This exclusive scale-shedding design completely eliminates band scaling.* Variations in temperature cause changes in the curvature of the tubes, thereby shedding the scale from the tube surface at regular cracking periods and during normal operation.

In addition, the G-R Bentube Evaporator offers distinctive features that assure 100% effective evaporating surface, pure dry vapor, minimum pressure drop of steam through the evaporator, free dropping of scale to the bottom of the shell and convenient access to the shell interior.

BULLETIN 366 *fully describes the wide-range line of* G-R BENTUBE EVAPORATORS. *Write for your copy today.*

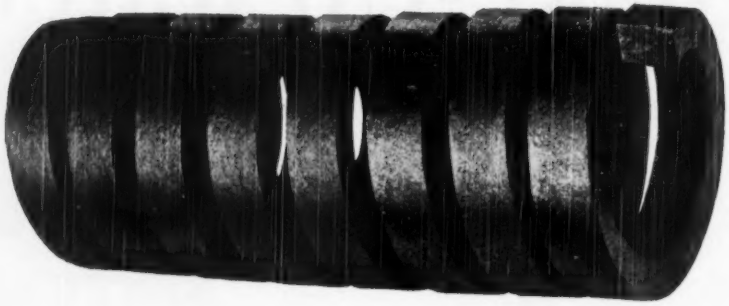
THE GRISCOM-RUSSELL CO. • 285 MADISON AVE., NEW YORK 17, N. Y.

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

versi-pak®

A NEW AND HIGHLY VERSATILE PLASTIC PACKING



versi-pak is the result of more than two years of testing and development. This new plastic packing can be used in an exceptionally large number of applications, and simplifies storage and inventory problems. It is being used successfully in reciprocating and centrifugal equipment and in hydraulic systems. Recommended for temperatures up to 350°F.; pressures up to 600 p.s.i.; against air, water, low-pressure steam, and a long list of chemicals. Available also in non-graphited form (R/M No. 1846) for use in food-handling equipment. For your free copy of the new bulletin on **versi-pak** send the coupon below to the Packing Division, Manheim, Pa.

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.
No. Charleston, S.C.; Passaic, N.J.

Raybestos-Manhattan, Inc. P-70
Packing Division, Manheim, Pa.

Gentlemen: ☐ Please send me a free copy of the **versi-pak** bulletin.

Name_____

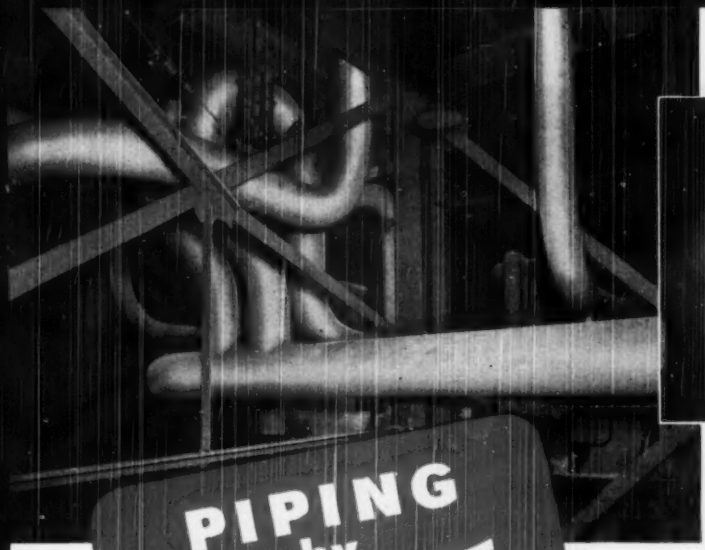
Position_____

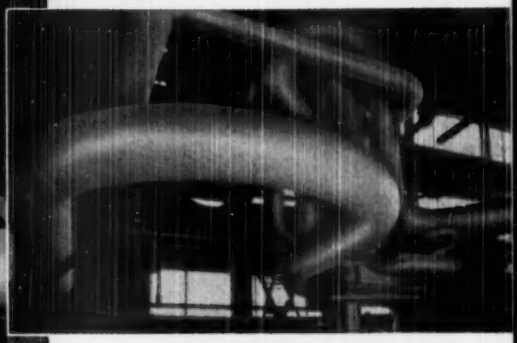
Company_____

Address_____

City_____ Zone____ State_____

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment Brake Linings • Brake Blocks • Clutch Facings Fan Belts • Radiator Hose • Powdered Metal Products • Bowling Balls



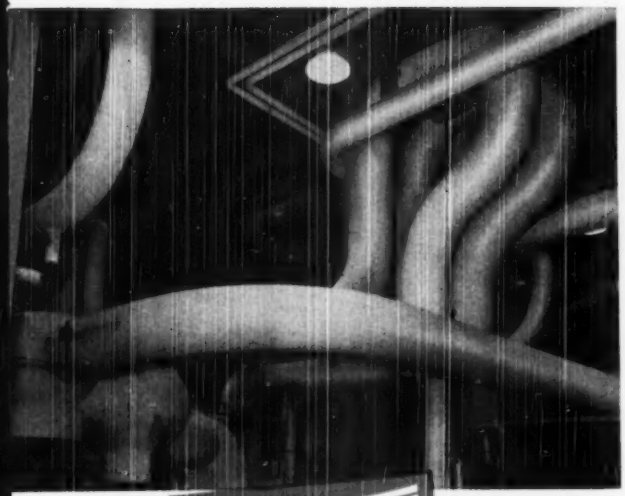


PIPING by MIDWEST

ANOTHER "First"

NEW SCHILLER STATION

First Complete Mercury-Unit Power Plant



The first installation of a mercury-unit power plant designed and built as a complete power generating unit . . . the Schiller Station of the Public Service Co. of New Hampshire at Portsmouth, N. H. is a notable achievement. When operating at designed rating of 40,000 kw and using Bunker C fuel oil, the heat rate is 9200 Btu per net kwhr.

The piping is by Midwest . . . fabricated and erected with undivided responsibility. "Firsts" are frequent with Midwest . . . have been throughout our more than four decades of experience with piping of all kinds. Midwest has grown up with modern high pressure and high temperature piping . . . through the years has achieved a wide reputation for better piping.

Whether you want a simple pipe bend, a series of complex prefabricated subassemblies, or a difficult piping job completely erected, Midwest has the facilities, the experience and the organization to meet every requirement. You will find it to your advantage to call upon Midwest whenever you need piping.

4 Plants are Better Than 1

MIDWEST PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic, Los Angeles and South Boston • Sales Offices: New York 7—30 Church St. • Chicago 3—79 W. Monroe St. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. South Boston 27—426 First St.

4163

PIPING FABRICATORS AND CONTRACTORS

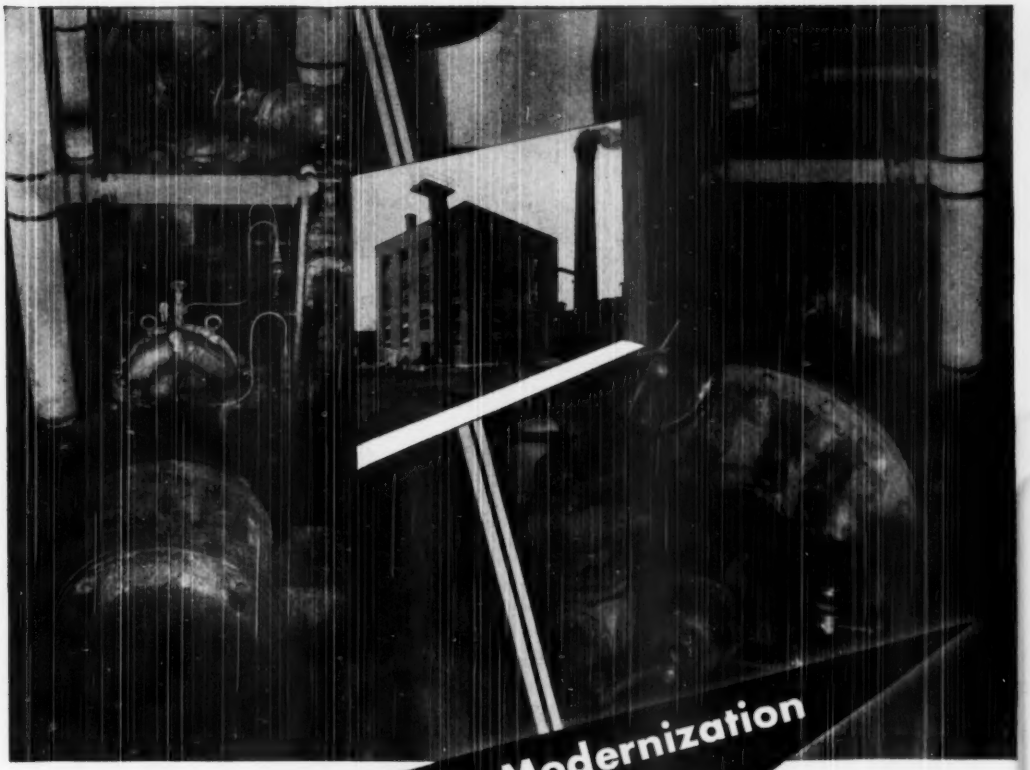
TRAIN VIBRATIONS DON'T BOTHER RUGGED C.H.W. WATER COOLING TOWERS

Speeding express trains and thundering freights can cause serious vibrations with damaging effects on equipment located nearby. Here's a C. H. W. water cooling tower installed so close to one of the country's heaviest traveled railroads that passing trains nearly knock your hat off. This tower of The Bayer Company, aspirin manufacturers at Trenton, N. J., is as good as the day it was built. And there are many good reasons why they haven't had any "headaches" with it. In a C. H. W. cooling tower you get a sturdy structure, assembled by experts, with redwood members rugged enough to withstand stresses, strains and vibrations (caused by trains or most anything else up to hurricane winds of 100 m. p. h.). Wood fill is of sufficient size and weight to "stay put" without the use of nails, and vertical members are securely bolted. A distorted distribution system or wood fill "out of place" affects the efficiency of the tower—hence the reason for C. H. W.'s "vibration proof," rugged construction. For other exclusive features of C. H. W. towers, write for literature.

C. H. WHEELER MANUFACTURING CO.
1800 Sedgley Avenue, Philadelphia 32, Pa.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

C. H. Wheeler SINCE 1903

STEAM CONDENSERS · WATER COOLING TOWERS
EJECTORS · STEAM JET VACUUM REFRIGERATION
OF PHILADELPHIA



Another Modernization Case History:

has been written . . . this time at

Susquehanna Mills, Inc., Sunbury, Pa.

. . . where the management, in cooperation with its consulting engineers, the Franklin Engineering Corporation, designed, built and put in operation an entirely new and very modern steam plant. This has resulted in substantial savings in labor and fuel costs, improved working conditions, and dependable steam generation to meet rapid load changes.

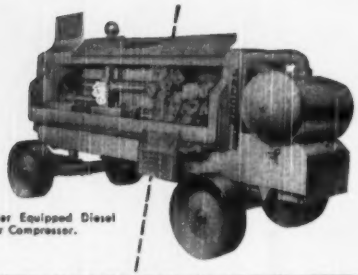
Two Warren two-stage pumps were selected for Boiler Feed Service. These pumps are single suction; opposed impellers of enclosed design; bronze fitted, and having a 2″ discharge; capacity 160 g.p.m., and 710′ t.d.h. One is driven by a 60 h.p., 3500 r.p.m., 220 volt, 60 cycle motor and the other by a 60 h.p., 3500 r.p.m. steam turbine.

Modernization or Expansion . . . Power Plant or Process . . . it will pay you, too, to check with Warren.

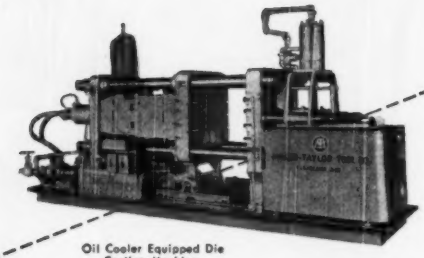
P-21

WARREN PUMPS

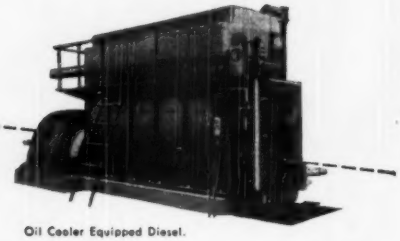
WARREN STEAM PUMP COMPANY, INC., WARREN MASSACHUSETTS



Oil Cooler Equipped Diesel Air Compressor.

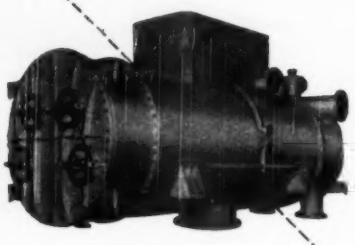


Oil Cooler Equipped Die Casting Machine.



Oil Cooler Equipped Diesel.

High Pressure Bleeder Heater.



Surface Condenser.

IN STOCK UNITS OR HIGHLY SPECIALIZED DESIGNS

ROSS STANDARDIZATION

BRINGS TIME-SAVING, COST-SAVING BENEFITS

As both machinery manufacturers and users well know, Ross' complete standardization and mass production of smaller size exchangers enable the immediate shipment of many units from stock and the immediate assembly of many others from stocked parts. The net result is extensive use of Ross exchangers as original accessories by the Diesel, hydraulic machinery and like industries.

But the time-saving, cost-saving benefits of Ross standardization are not limited to size and type. Many apply to even the most specialized of custom-engineered exchangers. For having completely standardized and carefully classified all essential components of such larger, more complex equipment as power plant surface condensers, refinery heat exchangers*, high pressure bleeder heaters or mammoth fuel oil heaters . . . Ross can eliminate many of the engineering and fabricating costs and delays commonly associated with specially engineered units.

* Ross refinery type heat exchangers conform thermally and mechanically to standards of Tubular Exchanger Manufacturers Assn. of which Ross is a member.

ROSS

EXCHANGERS . . . MAKE OTHER PRODUCTS BETTER

As part of your program for greater plantwide productivity, it would be to your advantage to be familiar with the full details of cost-reducing, time-reducing Ross standardization. Write.

ROSS HEATER & MFG. CO., INC., Division of American Radiator & Standard Sanitary Corp., 1415 West Ave., Buffalo 13, N. Y.

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILER • ROSS HEATER • TONAWANDA IRON

THE ANCHOR PACKING COMPANY

PRESENTS

ChromeLock

NEW

Adhesive Backed, Impregnated Felt Gasketing . . .

For corrosion proof, water, air and dust tight sealing of all faying surfaces such as lapped, butted or flange type joints.

Chrome Lock gasketing material consists of a high grade felt containing wool, impregnated to adhere to metal, glass, wood, concrete and plastics. Stays put on vertical or inverted surfaces. No odors. Non toxic. No clean-up. Has cut application man hours and over-all gasketing costs upwards of 50%.

Chrome Lock maintains continued pliability and does not embrittle with age or under heavy pressure. Acts as a cushion, prevents leaks due to vibration and shock, because, under pressure, Chrome Lock extrudes a thin protective coating onto the faying surfaces.

Chrome Lock is available in rolls, tapes and stamped. *Four thicknesses:* 1/32", 1/16" (100'), 1/8" (50') and 1/4" (25'). *Any width* from 3/16" to 66".

Contact our nearest Branch Office for color folder describing Chrome Lock.

BRANCH OFFICES

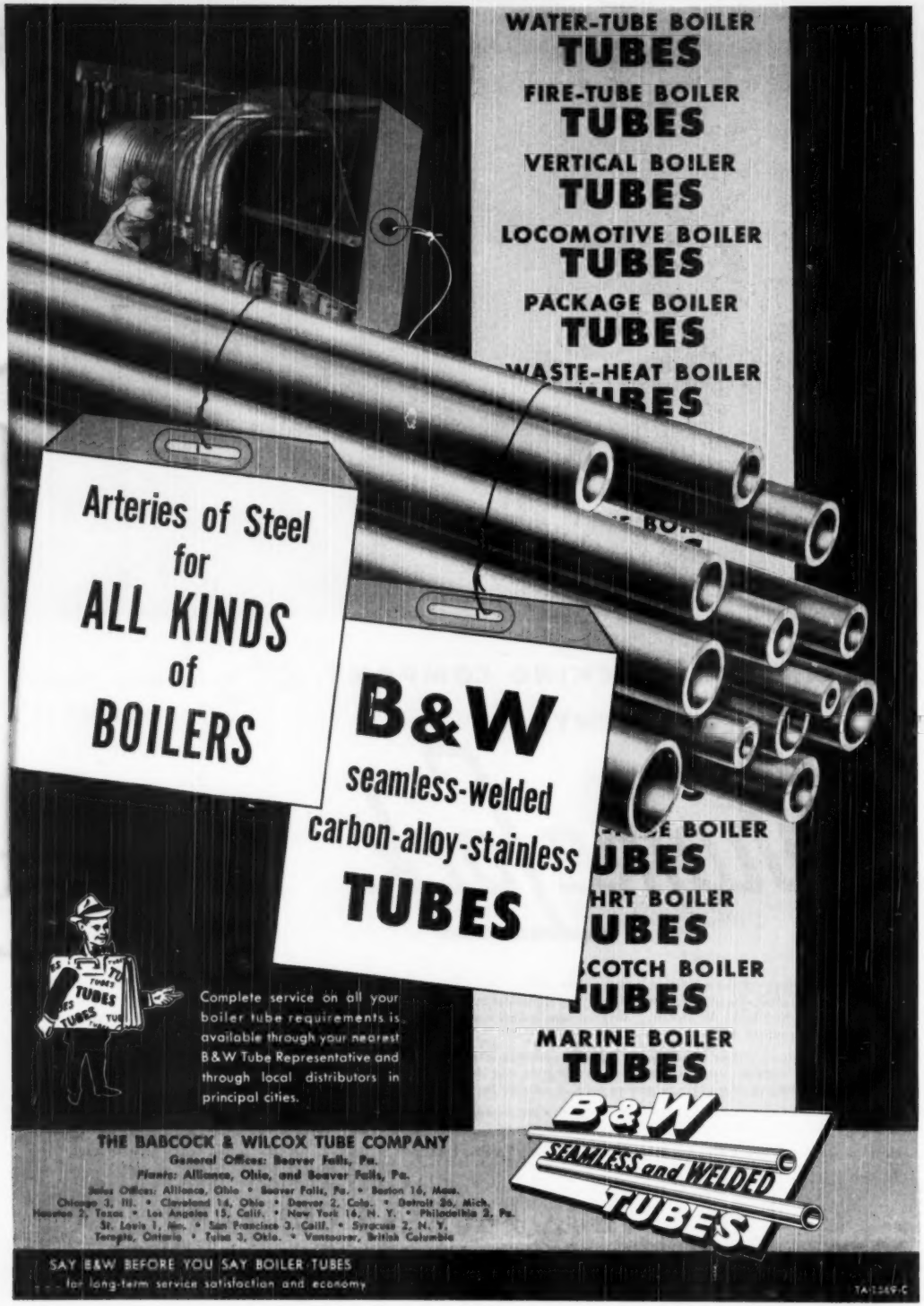
BALTIMORE, MD. — MILWAUKEE, WIS.
BOSTON, MASS. — MONTREAL, CANADA
BUFFALO, N. Y. — NEW ORLEANS, LA.
CINCINNATI, OHIO — NEW YORK, N. Y.
CHICAGO, ILL. — PHILADELPHIA, PA.
CLEVELAND, OHIO — PITTSBURGH, PA.
DAYTON, OHIO — SAN FRANCISCO, CAL.
DETROIT, MICH. — SEATTLE, WASH.
HOUSTON, TEX. — SPOKANE, WASH.
INDIANAPOLIS, IND. — ST. LOUIS, MO.
LOS ANGELES, CAL. — TOLEDO, OHIO
WILMINGTON, CAL.

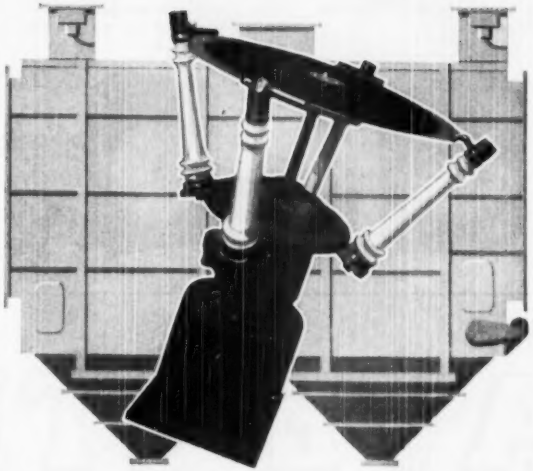
THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE


WATER-TUBE BOILER
TUBES
FIRE-TUBE BOILER
TUBES
VERTICAL BOILER
TUBES
LOCOMOTIVE BOILER
TUBES
PACKAGE BOILER
TUBES
MARINE BOILER
TUBES
Arteries of Steel
for
ALL KINDS
of
BOILERS
B&W
seamless-welded
carbon-alloy-stainless
TUBES
Complete service on all your boiler tube requirements is available through your nearest B&W Tube Representative and through local distributors in principal cities.
THE BABCOCK & WILCOX TUBE COMPANY
General Offices: Beaver Falls, Pa.
Plants: Alliance, Ohio, and Beaver Falls, Pa.
Sales Offices: Alliance, Ohio • Beaver Falls, Pa. • Boston 16, Mass.
Chicago 3, Ill. • Cleveland 14, Ohio • Denver 2, Colo. • Detroit 26, Mich.
Houston 2, Texas • Los Angeles 15, Calif. • New York 16, N. Y. • Philadelphia 2, Pa.
St. Louis 1, Mo. • San Francisco 3, Calif. • Syracuse 2, N. Y.
Toronto, Ontario • Tulsa 3, Okla. • Vancouver, British Columbia
B&W
SEAMLESS and WELDED
TUBES
SAY B&W BEFORE YOU SAY BOILER TUBES
for long-term service satisfaction and economy



ELECTROSTATIC ...YES

DESIGN-STATIC ...NO

The advent of the Buell 'SF' Electric Precipitator breathes new life into precipitator design. High efficiency recovery of ultra-fine dusts, fumes and vapors takes on new operating ease and reliability.

Both management and plant engineers will find in the Buell 'SF' Precipitator sound reason to anticipate superior performance. Advanced design provides self-tensioned Spiralectrodes (patented), and incorporates an exclusive StediFlow dust-fall principle. Either as Precipitator alone, or in combination with Buell van Tongeren cyclones, there is definite operating advantage.

Like all Buell Dust Collection Systems, each 'SF' Precipitator installation is custom-engineered for the job it will do...backed by a realistic fractional efficiency guarantee...produced against a background of world experience in dust collection.

For general information or specific performance data, write Buell Engineering Co., Inc., 70 Pine Street, New York 5, N. Y.

ELECTRIC CYCLONIC

Engineered Efficiency in **buell** **Dust Collection**

RECORDING FULSCOPE® CONTROLLER

For desuperheaters, or for any close, accurate control of temperature, pressure, flow or liquid level. Quickly adapted to any operating requirements.

RECORDING THERMOMETER OR PRESSURE GAUGE

Ideal wherever you need a record of pressure, temperature or a combination of both. Accurately records steam and feed water temperatures and pressures or oil, air and flue gas temperatures.

TAYLOR DIAL THERMOMETER

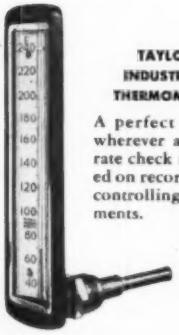
For transformers, coal-air mixture in powdered coal ducts, air compressor discharge, turbine and generator bearings. Available with electric alarm devices.

SAVE STEAM

with Taylor Cost Cutters like these

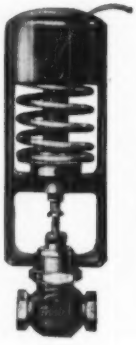
STOP those dollars from going up in steam! Let Taylor Instruments help you get credit for increasing operating efficiency and cutting costs. Select what you need from our complete line of instruments for accurate measurement or control of temperature, pressure, flow and liquid level. Ask your Taylor Field Engineer! Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.*

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY



TAYLOR INDUSTRIAL THERMOMETER

A perfect choice wherever an accurate check is needed on recording or controlling instruments.



TAYLOR SELF-ACTING TEMPERATURE CONTROLLER

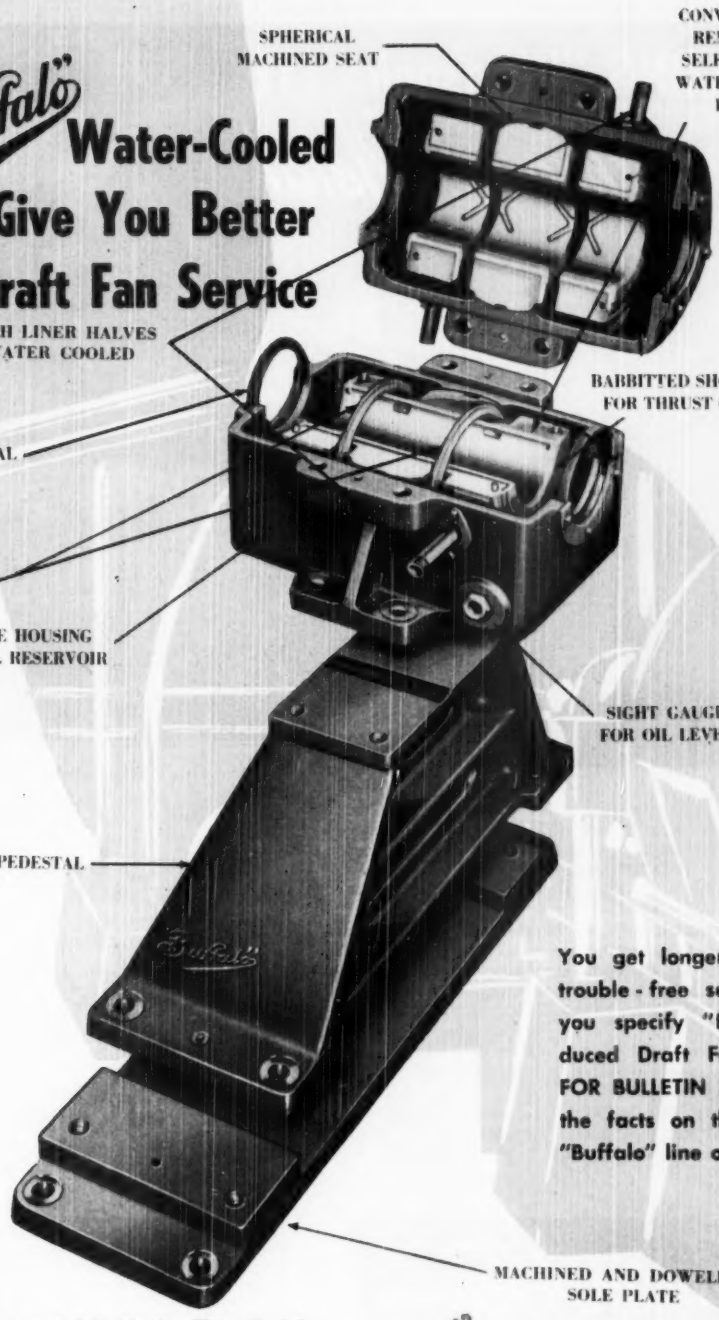
For dependable control on hot water storage tanks, air compressor jacket water.

ARMORED ETCHED STEM THERMOMETER

Ideal wherever you need a test check on temperatures. Also available in unarmored types.

® Registered Trade Mark

Why "Buffalo" Water-Cooled Bearings Give You Better Induced Draft Fan Service



Close-up Showing Details of Self Aligning Water Cooled Bearing and Pedestal

You get longer and more trouble-free service when you specify "Buffalo" Induced Draft Fans. WRITE FOR BULLETIN 3750 for all the facts on the complete "Buffalo" line of draft fans.

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Branch Offices in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

AMAZING "Ultrasonic" EYE
Sees Through Metal

at
Pittsburgh Piping
AND EQUIPMENT COMPANY

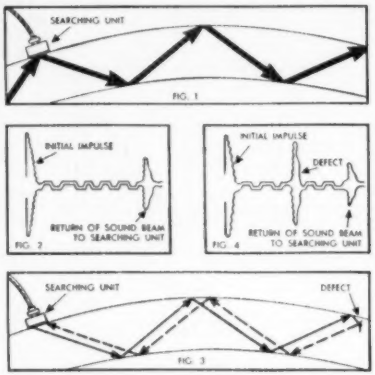
The illustration above shows P.P.&E. high pressure, high temperature piping being tested by means of a Reflectoscope which produces pulses of vibration waves of a frequency above hearing and transmits them at an angle into the metal through a searching unit which contains a sensitive quartz crystal.

The slightest discontinuity in the metal interrupts transmission of the waves, reflecting them back to the searching unit where the crystal converts mechanical vibrations into electrical energy. This voltage, amplified in the receiver, produces a visual indication of the defect on the screen of a cathode ray tube.

This unique testing method can detect flaws that can be found by no other non-destructive test. Its use assures quality control of materials and welding.

Look to Pittsburgh Piping and Equipment Company for leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

How the *"Ultrasonic"* Eye Works

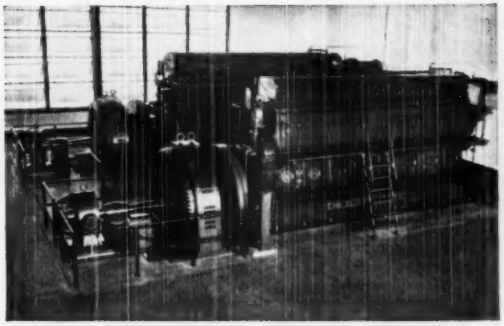


Intermittent ultrasonic vibrations are transmitted angularly into the section under inspection, so that each sound beam is reflected away from its point of origin progressively from inner to outer pipe wall surface in a consistent pattern, as shown in Fig. 1, until it circles the pipe and returns to the searching unit. The uninterrupted flow and return of the beam is indicated on the oscilloscope screen as diagrammed in Fig. 2. Any discontinuity in the metal lying in the path of the sound beam will interrupt transmission as shown in Fig. 3, reflect the sound back to the searching unit, and provide a visual indication of its presence and location on the oscilloscope screen (see Fig. 4).

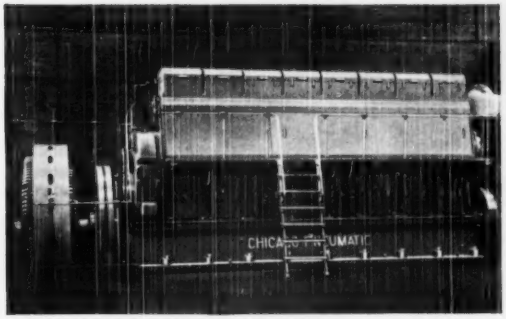
Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street—Pittsburgh, Penna.

Woolworth Building, New York
Whitehead Building, Atlanta
Book Tower, Detroit
525 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston

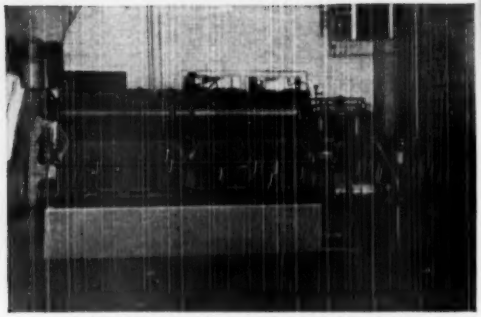
CP medium and slow speed Diesel Engines



Two CP 1500 H.P. Diesels in a western public utility station.



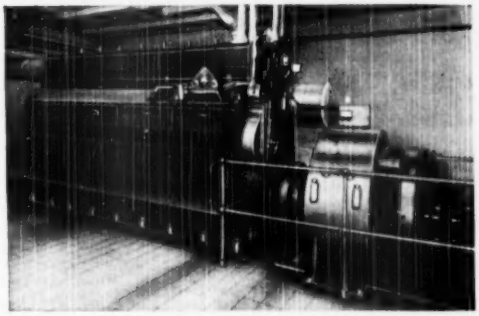
CP 1650 H.P. 8-cylinder Diesel in well known industrial plant.



CP 400 H.P. Diesel in petroleum pipeline station.

Available in sizes ranging from 120 H.P. to 1750 H.P., these engines can be furnished either for straight Diesel or for Dual Fuel operation. The CP line includes both normally aspirated and supercharged engines, all the latter incorporating the thoroughly dependable Elliott-Buchi Turbocharger.

CP Diesels have proved profitable investments for public utilities; industrial, municipal, ice and waterworks plants; and in mining, oil, pipeline, cotton ginning and other fields where low cost, dependable power is a vital necessity. Write for complete information.



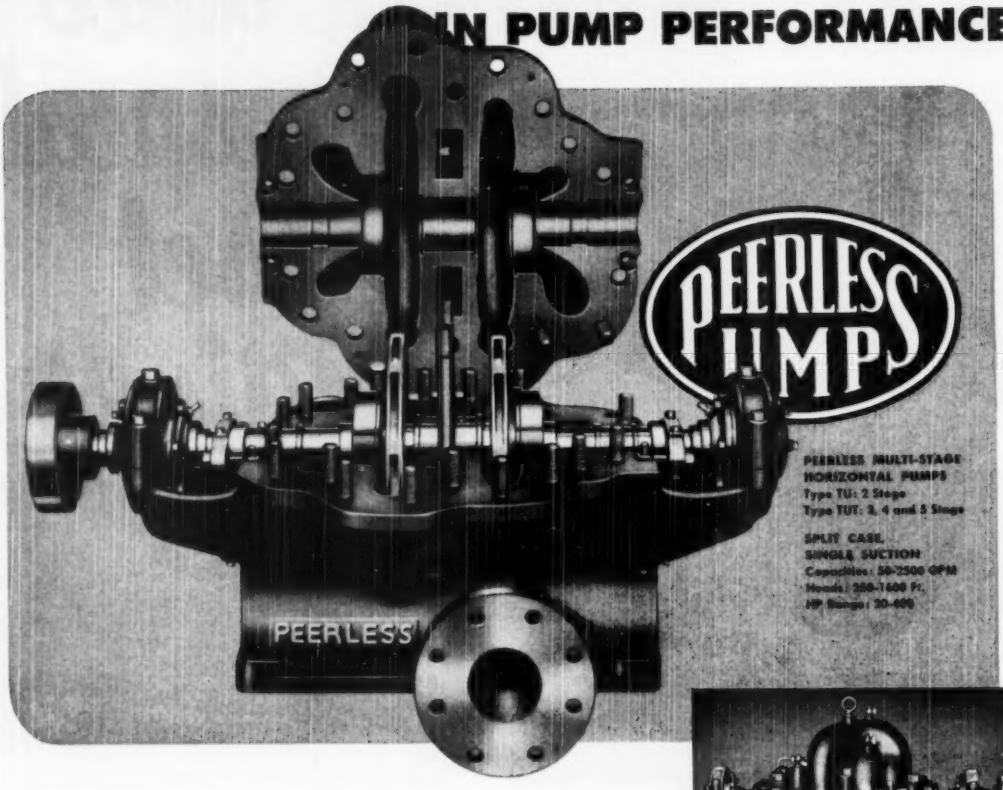
CP 640 H.P. Diesel in large laundry.

CHICAGO PNEUMATIC TOOL COMPANY

General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

PEERLESS PROVIDES A PLUS IN PUMP PERFORMANCE



PEERLESS TYPE TU PUMP WITH THE CASE SPLIT FOR A LOOK AT CONSTRUCTION FEATURES

Peerless Type TU and Type TUT multi-stage horizontal pumps squarely meet your requirements where moderate capacity and high head applications in handling boiler feed water and process liquids are involved. In general, these pumps are of horizontal, split-case design. They incorporate a number of features that provide a plus in pump performance without paying a premium on your investment.

For example: Peerless TU and TUT pumps are equipped with duplex angular contact thrust bearings, water cooled bearing housings, heavy stiff case rings, sleeves locked against impeller hubs, in-and-out cooling and sealing connections at stuffing box.

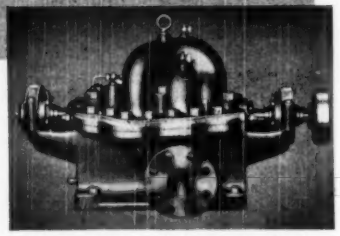
The return passages from discharge to suction of the impellers is the best method developed over a period of years for converting velocity into pressure between stages providing a definite improvement in efficiency.

The high pressure stuffing box on these pumps is under one stage pressure only, regardless of the net pressure developed by the pump.

The spacer bushings between stages are serrated with grooves throughout its length, are longer than competitive pumps thus making an effective seal between stage pressures. The serrations allow closer clearances and minimize any tendency to bind.

Shafts are rugged for the HP involved and will bear comparison with conventional pumps.

Peerless Type TU and TUT pumps are described in Bulletin B-301. Write for your copy today.



Exterior view of Type TU 2-stage pump showing internal cross-over as furnished on 4" size and smaller.

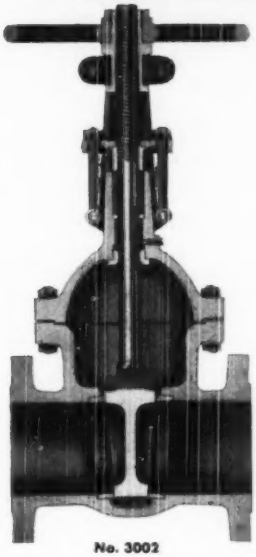
View in booster station shows Type TUT 3-stage pumps each handling 325 gpm of process water at 600 ft. head.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories: Los Angeles, California, and Indianapolis, Indiana.
Offices: New York, Atlanta, Chicago, St. Louis, Phoenix, Fresno, Los Angeles; Dallas, Plainview and Lubbock, Texas; Albuquerque, New Mexico.

OHIO EDISON CO. is one of the many light and power companies throughout the nation that use OIC Valves. Pictured is the Ohio Edison Gorge Power Plant that supplies a portion of the electricity requirements of the Greater Akron area.

OIC

SETS THE PACE IN VALVES



No. 3002

IN THE NATION'S LIGHT AND POWER PLANTS

OIC Valves are the answer to the demands of light and power companies for valves that function with absolute precision and safety for long periods of time. There are good reasons — dozens of pace-setting features that show why OIC Valves are steadily gaining nation-wide preference.

There are no flow obstructions to cause turbulence and pressure drop in OIC Valves. OIC Valves have streamlined, straight-through ports with inner walls as smooth as glass! The heavy I-beam wedge rises entirely clear of the fluid passageway. There are no recesses or pockets between the valve body ports and the seat openings. And OIC Valves are built with rugged strength to withstand the highest pressures. OIC Valves give you extra body-wall thickness . . . precisely calculated flange and gasket dimensions . . . accurate distribution of materials to prevent concentration of stresses in any one part.

OIC Valves save you money by helping you avoid extra pumping. You get *steady* pressure you can depend on! You handle your flow requirements more efficiently — more economically!

Eliminate Change-Over Difficulties with the Handy OIC Cross Reference Chart Just check the number of the valve that you wish to replace, look in the OIC Cross Reference Chart, and you will find the number of the OIC Valve to replace it. For your free copy, write to *The Ohio Injector Company, Wadsworth, O.*

OIC VALVES

0 549-10

CAST STEEL • FORGED STEEL • IRON • BRONZE

THIS MAN WOULDN'T NEGLECT

A MACHINE IN HIS PLANT

...yet he hasn't had a Chest X-Ray!

He checks every piece of mechanical equipment he owns for wear, lubrication, efficiency.

Yet he fails to take the simple precaution of a Chest X-Ray to make sure he does not have tuberculosis. *Not because he's opposed to the X-Ray. Simply because he is not sufficiently informed—or just hasn't taken the time and trouble, or does not realize the seriousness of the problem.*

A Chest X-Ray is the first step toward detecting tuberculosis in its early stages. And in its early stages it can be cured with the least loss of time from work.

So, if you're the man above, that one simple reason should make you get your Chest X-Ray—*today*. But listen, see how serious this really is:

Between the ages of 15 and 34, tuberculosis leads all other diseases as a cause of death—although at no age are you safe from TB. Yet, if everyone does his part by getting a Chest X-Ray periodically, and the majority of cases thus discovered are followed up, we can eliminate TB entirely as a public health hazard!

Will you do your part today? Get a Chest X-Ray. It may mean your life!

Published in the public interest by:

McGRAW-HILL PUBLICATIONS

a sure way to cut maintenance costs!

● That's right. Republic's Champion Air Hose will cut a big chunk out of your maintenance costs . . . relieve you of many a maintenance worry.

It's a fact, proved over and over again under the toughest conditions possible.

You see, Republic's Champion is a top-quality, braided hose, combining ruggedness with extreme flexibility and light weight. It's built with a smooth, friction-reducing, oil-resistant inner tube, surrounded by multiple braids of specially processed, chemically strengthened yarn. Its thick, armorlike safety cover wards off destructive blows from falling objects . . . stands firm against abrasion and wear.

Champion Air Hose, with the yellow safety cover, is available in braided, mandrel-cured construction in 50-foot lengths.

Your local Republic Distributor can help you choose the right hose for your job. Consult the yellow pages in your telephone directory for his name or write direct for information.

Remember, for nearly a half century, Republic Rubber has been the specialist in the field of industrial rubber. Make it your headquarters for all your needs.

Pioneers in the use of COLD RUBBER

INDUSTRIAL RUBBER PRODUCTS BY

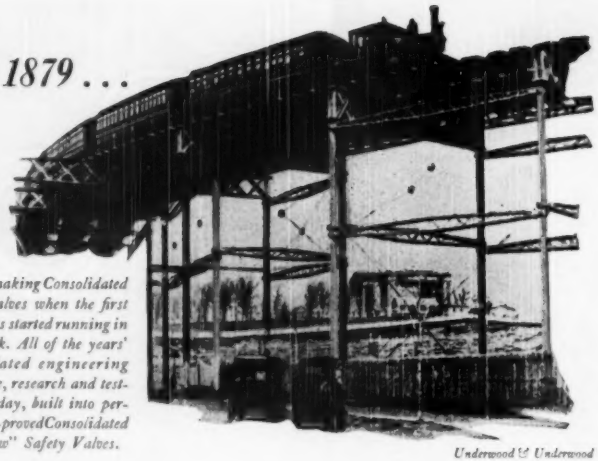
REPUBLIC RUBBER DIVISION

Lee Rubber & Tire Corporation

YOUNGSTOWN, OHIO

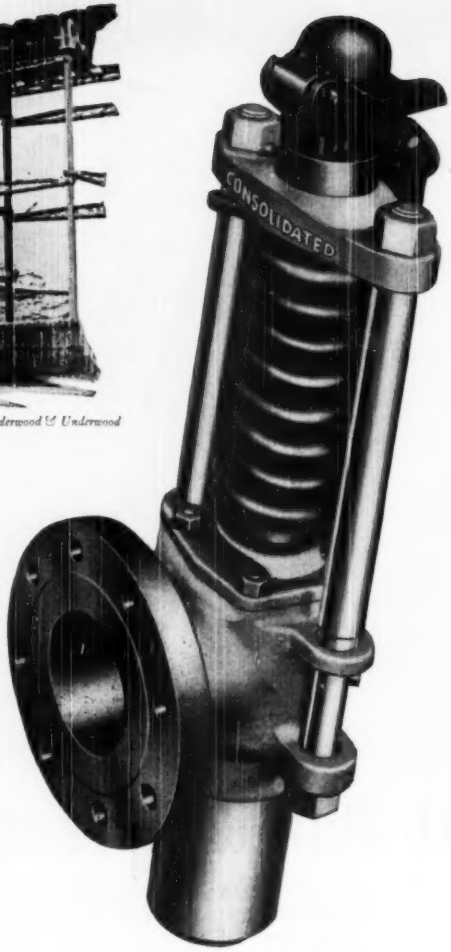
FOR LEE TIRES & TUBES • CONSHOHOCKEN, PA.

Since 1879 . . .



We were making Consolidated Safety Valves when the first "L" trains started running in New York. All of the years' accumulated engineering knowledge, research and testing is, today, built into performance-proved Consolidated "Maxiflow" Safety Valves.

Underwood & Underwood



There's over 70 years know-how built into CONSOLIDATED *Maxiflow* SAFETY VALVES

Maxiflow Safety Valves are new *in all that modern engineering can contribute.* But every feature of these valves has been proved by field experience over many years, and by long-time and severe testing methods.

In high pressure, high temperature installations, Maxiflow performance establishes a new standard in safety, efficiency and economy.

These Maxiflow design features mean important operating advantages:

Thermodisc Seat permits rapid equalization of temperature differentials. Thermal stresses are minimized, seat distortion cannot take place, permanent tightness is achieved.

Blowdown Control adjustable to a new, low minimum. The exclusive "micrometer" trim ring provides a simple and practical chatter-proof blowdown control, externally controlled and operable with valve under pressure.

Mechanical Through Bushing with precision machined surfaces that provide constant entrance conditions for steam flow. Eliminates leakage due to porous castings.

Retention of Popping Point is achieved by combining proper compensation with materials having low coefficients of expansion.

For complete description, plus capacity tables, write for the Consolidated Maxiflow Safety Valve Bulletin.

CONSOLIDATED *SAFETY* VALVES

A Product of

MANNING, MAXWELL & MOORE, INC.

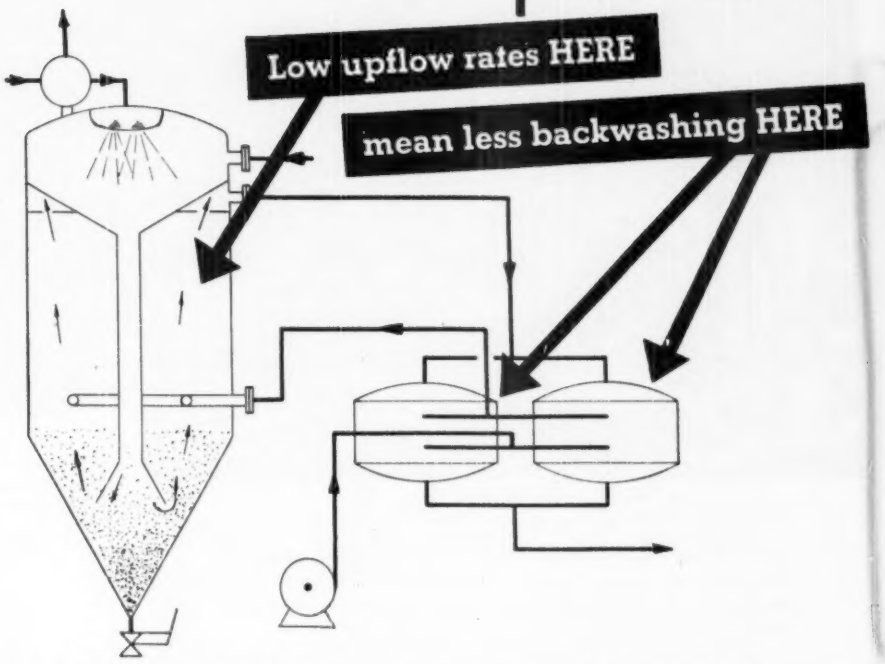
BRIDGEPORT 2, CONNECTICUT

Makers of 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electrical Instruments, 'Hancock' Valves, 'Ashcroft' Gauges. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists, and other lifting specialties.

Why GRAVER

HOT PROCESS SOFTENER FILTERS

Stay Cleaner



Among the many distinctive features of the GRAVER Hot Process Softener is the *low rising rate* of the treated water to the discharge after the softened water has passed through a dense bed of previously precipitated solids.

Compared to other hot process softeners, the GRAVER design provides as low as *half* the rising rate in a softener tank of given diameter and capacity. This means more efficient separation of precipitates and clearer treated water.

Therefore, the GRAVER Hot Process Softener is an effective *clarifier* as well as softener. It imposes less load on the filters . . . the filters stay clean longer . . . far fewer filter backwashings are needed . . . filter maintenance time and expense are greatly reduced . . . and in some instances, such as where a hot zeolite softener is used for second-stage treatment, filters may be unnecessary.

This principle of *more complete removal of precipitated solids within the softener tank* is one of many examples of GRAVER pioneering in water softener designs. For complete information on *all* the GRAVER Hot Process Softener advantages, write for Bulletin WC 102.

GW-427

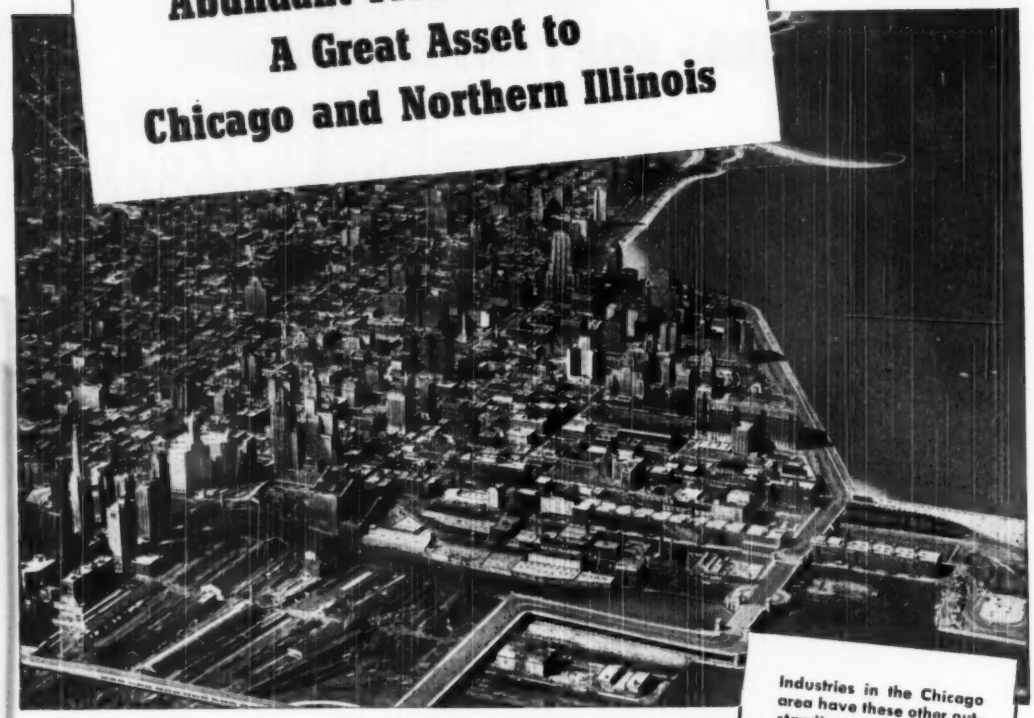
GRAVER

GRAVER WATER CONDITIONING CO.

216 West 14th Street, New York 11, New York, U. S. A.

A DIVISION OF GRAVER TANK & MFG. CO. INC. EAST CHICAGO, IND.

Abundant Fresh Water . . . A Great Asset to Chicago and Northern Illinois



An unfailing supply of fresh water, so essential to numerous industrial operations, is one of the chief assets of the Chicago area. And in addition to abundant water, industry in the Chicago area has the added advantage of the lowest cost water in the country.

Lake Michigan, at Chicago's front door, provides an unlimited source of water, immediately available for all uses. Continuously expanding pumping facilities, capable of furnishing approximately 2 billion gallons per day, assure uninterrupted water service to the 3,725,000 Chicagoans who are now utilizing Lake Michigan water. These users, and the users in nearby cities and villages of the Chicago area, have the security of knowing that Lake Michigan will continue to meet the growing demands of expanded industry and greater population.

In order to assure the purity of the water supplied through the Chicago water system, a vast filtration project is under way. The first unit is now completed. The complete project, as planned, will provide filtered water for the entire Chicago metropolitan area.

Industries in the Chicago area have these other outstanding advantages:

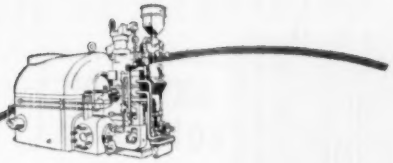
Railroad Center of the United States • World Airport • Inland Waterways • Geographical Center of U. S. Population • Great Financial Center • The "Great Central Market" • Food Producing and Processing Center • Leader in Iron and Steel Manufacturing • Good Labor Relations Record • More than 2,500,000 Kilowatts of Power • Tremendous Coal Reserves • Good Government • Good Living • Good Services for Tax Dollars.

You are invited to write for information concerning Chicago's advantages for your business. We will gladly furnish you a confidential survey of conditions here, as they apply to your specific problem. There is no obligation, of course.

TERRITORIAL INFORMATION DEPARTMENT

Marquette Building—140 South Dearborn Street, Chicago 3, Illinois

COMMONWEALTH EDISON COMPANY • PUBLIC SERVICE COMPANY OF NORTHERN ILLINOIS
WESTERN UNITED GAS AND ELECTRIC COMPANY • ILLINOIS NORTHERN UTILITIES COMPANY



Positive Safety when Engines, Turbines or Compressors Overspeed

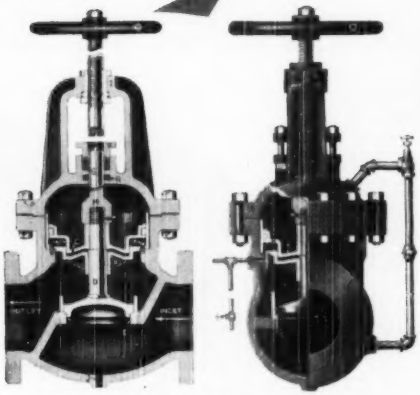
GOLDEN-ANDERSON throttle and automatic engine stop

Valves

MECHANICALLY OR ELECTRICALLY TRIPPED

Golden-Anderson Throttle and Automatic Engine Stop Valves assure automatic shut-down and protection from damage when turbines, compressors or engines overspeed. A single speed governor trips a pilot control valve directly, or indirectly trips a solenoid-electric pilot control valve which causes this valve to automatically close against inflow pressure. All Golden-Anderson valves are cushioned by the "Double-Corliss" dashpot assembly to prevent banging and chatter.

Write for technical data.



G-A combined throttle and automatic engine stop valve, globe pattern.

GOLDEN-ANDERSON *Valve* SPECIALTY COMPANY

2070 KEENAN BUILDING · PITTSBURGH 22, PA.

LIFE AND PROPERTY PROTECTION
VALVES SINCE 1905

Gear yourself for quicker advancement

with these McGraw-Hill engineering manuals

ARE YOU EQUIPPED to handle your job? —to get a new one?

The men who are keeping their jobs today—and in line for better jobs tomorrow—are those who are keeping one jump ahead. It works in the power plant field as well as any other. Some men fit themselves to be a little more valuable than the next fellow, and when the cards are down, they get the break. How about you? Do you know how quickly knowledge will pile up when you spend a few minutes a day studying sound books like the McGraw-Hill Library of Power Plant Practice? Do you know how easily it can be managed, paying only a few cents per day while you use the books?

Thousands of men have followed this plan to win advancement or to make their jobs safe. You can too. Read all about this Library and Our Free Examination Offer. Then send the attached coupon.

POWER PLANT PRACTICE

6 volumes—2,477 pages, 2,404 illustrations

The Library of Power Plant Practice is the standard of the power plant field. It is accurate, thorough and easy to understand . . . the result of years of experience with power plant problems. The man who owns these books has the best. No books dealing with the work of the power plant man were ever so authoritative—so practical in text and illustrations—as these. The man who puts this set of books into his library can do so knowing that he has the utmost in power plant books—a set that will give him all the information he needs to get ahead in his work.

Easy to understand

This is a Power Plant Library FOR POWER PLANT MEN, written in everyday, easy-to-understand language. There is no bunkum or useless theory—every word is planned to give you practical information to help you on your job.

See it 10 days — Send no money

Mail the coupon below and we will send you the six volumes for examination. If you decide to keep the books, just send $3.50 at the end of 10 days, and then $3.00 per month until the low price of $18.50 has been paid.

1 MECHANICAL ENGINEERS' HANDBOOK

Edited by Lionel S. Marks

Thousands of mechanical engineering facts—theory, standards, practices and data—arranged for quick reference. The sort of material you might accumulate in years of experience and study compiled for you in one convenient volume. Contains authoritative tables, diagrams, methods, formulas, etc. prepared by 90 specialists in every branch of engineering. If your engineering library were limited to one book, Marks' Handbook would be the most valuable selection to help you avoid errors and save time in your engineering problems. 2276 pages.....$10.00

2 AIR CONDITIONING and Elements of Refrigeration

By Samuel P. Brown

A practical book for planning and installing air conditioning or refrigeration equipment. Every factor relative to design, installation, operation and maintenance is discussed in detail—how to estimate your needs for dwelling, office or factory, how to assure the most efficient and economical performance, dehumidification, and hundreds of other pertinent facts that will guide you in your selection and installation. The theory and practical operation of cooling equipmpent are explained clearly and thoroughly. Over 300 graphs, tables and illustrations. 644 pages.....$6.00

3 STEAM POWER PLANT AUXILIARIES and ACCESSORIES

Edited by Terrell Croft • Revised by D. J. Duffin

Here's a manual that shows how to select steam power plant equipment . . . that spotlights methods of installing, maintaining and operating it for greatest efficiency and economy. It outlines in clear-cut detail the facts you must know about each piece of equipment. 534 excellent drawings, diagrams, charts, tables, and photographs illustrate modern equipment —illuminate the descriptions. Second edition, 538 pages, 534 figures, 7 tables.....$5.00

4 ENGINE ROOM Questions and Answers

By Alex Higgins

A clear, easy-to-follow guide on design, construction, and operation of steam engines, steam turbines, and their accessories. It gives you concrete help on all power plant operating problems . . . enables you to learn the all-important fundamentals quickly and easily. The answers to the 394 questions most frequently asked in examinations for operating engineer certificates are given in concise, easily-understood language. 184 pages, 224 illustrations..$4.00

5 Instrument and Control Manual for Operating Engineers

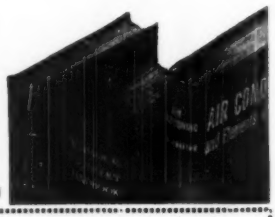
By Eugene W. F. Feller

For the man in the plant who needs information on how to solve all kinds of metering and control problems. It explains basic principles of control . . . describes construction and operation of liquid level, pressure, temperature, speed, humidity indicators and controllers. A valuable guide for the plant engineer. 426 pages.....$6.00

6 WATER TREATMENT and PURIFICATION

By William J. Ryan

Your industrial water supply problems are solved in this practical, up-to-date guide. All of the latest effective treatments for removing impurities from water are explained—the recent developments of the sedimentation tank, coagulation basins, chemical methods, ion exchange apparatus and sterilization processes are covered with special attention given to treating boiler feed water. Shows the most economical and practical methods for preventing boiler embrittlement and pipe line scale deposits, 66 diagrams and illustrations. 270 pages.....$3.25



7 AMERICAN ELECTRICIANS' HANDBOOK

By Terrell Croft

Here are hundreds of detailed descriptions, rules, methods, pictures and practical data to help you install, maintain, and operate electrical equipment. Shows you how to select and install commercial electrical apparatus and materials for the performance of specific services . . . gives facts that help you operate electrical equipment efficiently . . . includes time-saving tips like these: how to construct circuit testing devices—how to figure discounts in estimating—how to connect 3-wire generators—how to calculate the lead on motor feeders and mains—etc. 6th Edition. 1727 illustrations and tables. 1734 pages.....$6.00

Use this coupon to order library or any of the engineering manuals listed.

McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18

☐ Send me the **Library of POWER PLANT PRACTICE**, 6 vols. If satisfactory I will send $3.50 in 10 days and $3.00 each month until the price of $18.50 has been paid. If not wanted, I will return the set to you postpaid.

☐ Send me book(s) corresponding to numbers encircled below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery, and return unwanted book(s) postpaid. (We pay for delivery if you remit with this coupon; same return privilege.)

1 2 3 4 5 6 7

Name .....

Address .....

City ..... Zone ..... State .....

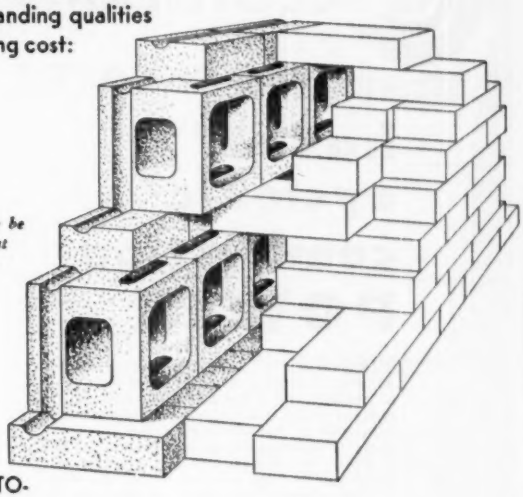
Company .....

Position PP-7-50

This offer applies to U. S. only

For Efficient Operation of Air-cooled Boiler Walls — NOTHING Beats the Serviceability of CRYSTOLON® BLOCKS

CRYSTOLON Hollow Blocks are specially designed for the scientific construction of air cooled walls in boiler furnaces. In addition to their unique design, these blocks (like CRYSTOLON Bricks for solid walls) possess the four basic outstanding qualities of silicon carbide. The result is lowered boiler lining cost:



Crystolon air-cooled blocks may be obtained in the shapes illustrated at the right (Type A) or in T or K shapes (designated as Types B and C).

(1) **Unusually high refractoriness.** Bonded CRYSTOLON Shapes are successfully used at temperatures up to 2900°F. (1595°C.).

(2) **Resistance to slag action.** The action of molten slag is tough on any refractory—but CRYSTOLON blocks and bricks are made so dense that slag will not take hold by penetration.

(3) **Resistance to clinker adhesion.** CRYSTOLON blocks and bricks are designed to reduce the adhesion of clinkers to a minimum. If clinkers do adhere to a limited extent, they are easily removed without any damage to the surface of the block or brick.

(4) **Resistance to abrasion.** Silicon carbide is an abrasive material of extreme hardness and, therefore, CRYSTOLON blocks and bricks show remarkable resistance to abrasion—including that caused by the moving fire bed of a stoker-fired furnace.

CRYSTOLON air cooled blocks are designed as a full block having a 9" base or as a half block with a 4½" base. They have a definite relation to the standard 9" CRYSTOLON straight brick and can be used in conjunction with it. In addition there are modifications of the 9" brick shapes, provided with standard tongues and grooves, for use in conjunction with the blocks as both headers and stretchers. The blocks are made with either a blank face or a perforated face having two or four holes.

NORTON
REFRACTORIES®
NORTON COMPANY
WORCESTER 6, MASSACHUSETTS

Because they're years ahead in steam generation..

only

CYCLOTHERM
STEAM
GENERATORS

Trade Mark Reg.

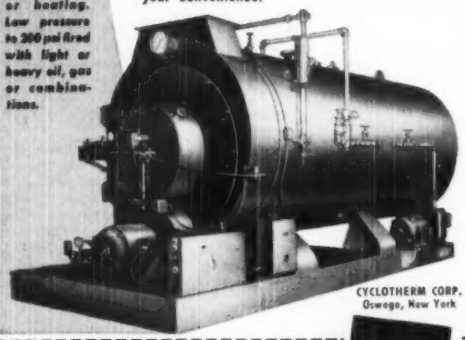
have cyclonic* combustion POWER

*WHAT IS IT? It's the modern scientific discovery of transferring heat at the highest degree of efficiency with a new low in fuel consumption. Principal factors of which are the cylinderized solid flame with its exclusive cyclo-motion power, designed to utilize the full potential of every particle of fuel . . . and the thin layer of air resulting from centrifugal force that's always between the flame and wall of combustion chamber. A combination to produce steam far in excess of conventional standards for measured heating surfaces.

SEND FOR ALL THE BIG REASONS

Learn how the completely automatic Cyclotherm with its unexcelled all-in-one package type features wipe out waste and excess costs. If you are planning a new or replacement boiler installation it will pay you to first get the facts on Cyclotherm. The coupon below is for your convenience.

SIZES available to fit your steam or water load for processing or heating. Low pressure to 200 psi fired with light or heavy oil, gas or combinations.



CYCLOTHERM CORP.
Oswego, New York

CYCLOTHERM CORP., OSWEGO, N. Y.

Gentlemen: Please send me bulletin P-1 showing the advantages of Cyclotherm's new concept in Heat Transfer. Without obligation, of course.

DEPT. P7

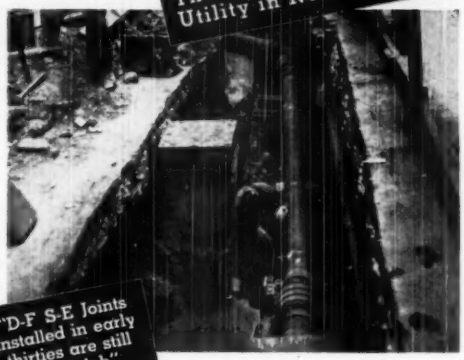
NAME _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

WHY THEY CHOOSE
Badger
EXPANSION JOINTS

The largest operating Utility in New England



"D-F S-E Joints installed in early thirties are still on the job"

Back in the early thirties the now-famous Badger Directed-Flexing principle was added to the Self-Equalizing construction. The principle underlying the idea (see illustration below) looked sound to the Utility Engineers and several joints were ordered and installed in their central heating distribution system. Badger D-F S-E Joints are still on the job.

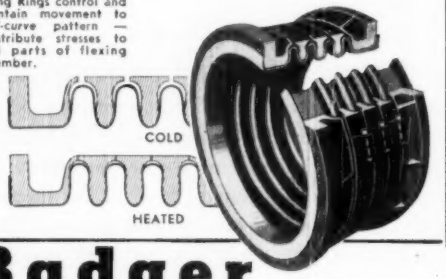
With this Utility, as with hundreds of others, Badger Directed-Flexing Self-Equalizing Expansion Joints are famous for performance. Reason? *Exclusive* construction features which guarantee longer life without maintenance. So be wise, figure in terms of *costs* and specify Badger Joints. Send for your copy of new 24-page catalog.

Badger Joints flex like this . . .

All-curve flexing guarantees longer life

not like this . . .

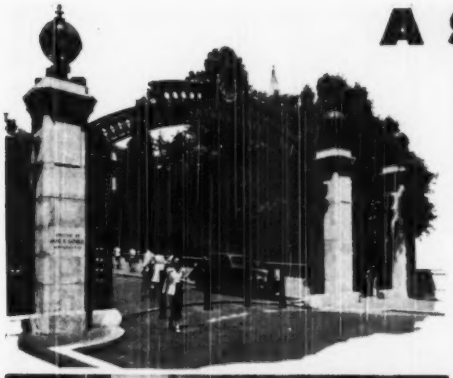
EXCLUSIVE construction of Badger Joints eliminates localized flexing stresses that cause breakdowns. Directed Flexing Equalizing Rings control and contain movement to *all-curve* pattern — distribute stresses to all parts of flexing member.



Badger

MANUFACTURING COMPANY

230-260 BENT STREET CAMBRIDGE 41, MASS.



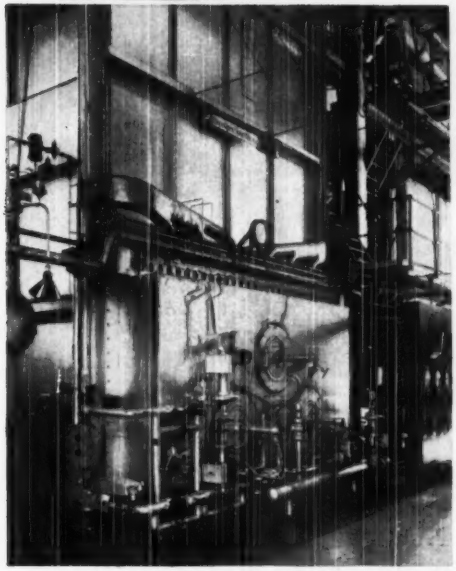
A STATE UNIVERSITY

Rates Its New . . .

ERIE CITY 3-DRUM BOILER

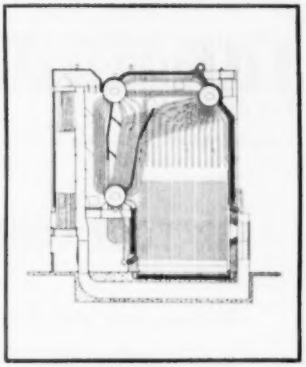
At

87.04% Efficiency



THIS type L Erie City oil fired 3-drum boiler complete with water wall cooling and air pre-heating has a nominal rating of 100,000 pounds of steam per hour and is designed to carry a heating load. It passed the acceptance test on Dec. 27, 1949, slightly better than predicted by Erie City engineers.

- Boiler Heating Surface . . . 9860 sq. ft.
- Water Wall Surface . . . 1260 sq. ft.
- Air Heater Surface . . . 7800 sq. ft.
- Furnace Volume . . . 4100 cu. ft.



STATE BOARD OBSERVES OFFICIAL TEST RUN

Boiler	Erie City Type L3-Drum	Fuel	Bunker "C" Oil.
Object of Test—		Percent CO_2	14.01
Determine capacity and efficiency of boiler.		Temperature gases leaving Boiler	599.2° F.
Date of Test	12-27-49	Temperature gases leaving Air Heater	375.7° F.
Steam Load	103,600 lbs. per hr.	Temperature air leaving Air Heater	355.4° F.
Pressure	133 p.s.i.(g)	Overall efficiency	87.04%

Installation and test under the supervision of Walter S. Leland Co.

Complete test data available upon request.

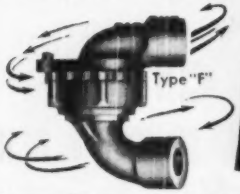
ERIE CITY

COMPLETE STEAM POWER PLANT EQUIPMENT

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*

. . . with 360° swing



FLEXO JOINTS assure unrestricted flow at all times

through moving pipe lines

• WHEN YOUR PROBLEM is conveying STEAM, AIR, WATER, OIL, etc. under high or low pressures through moving pipe lines or to equipment in motion, it pays to use *safe, dependable* Flexo Joints. Designed for 360° swivel movement, they combine the flexibility of hose and the strength of pipe . . . assure *full, free flow* at all times.

FEWER PARTS . . . LESS MAINTENANCE

Precision-made Flexo Joints contain just four simple parts completely enclosed from grit and dirt — no springs . . . no small or complicated parts . . . no ground surfaces to wear.

IMMEDIATE SHIPMENT . . . ALL STYLES, SIZES

Made in four styles for standard pipe sizes from ¼" to 3".

No need to worry about carrying stock. Flexo Joints are sent where they're needed when they're needed.

WRITE FOR COMPLETE LITERATURE

FLEXO SUPPLY CO., Inc.

4655 PAGE BLVD. ST. LOUIS 13, MO.

In Canada:

S. A. ARMSTRONG, LTD., 1400 O'Connor Drive, Toronto 13, Ont.

FOR YOUR CONVENIENCE

When you are looking for the answers to "What's available?" "Who makes it?" "Where can I get it?" —you'll find them quickly and easily in the

1950 Mid-June POWER Buyers' Guide Number

KEEP AND USE *YOUR* COPY

CONTROL *Scale and Corrosion*

IN BOILERS, WATER JACKETS, CONDENSERS

—Wherever Water is Used

Increase the efficiency and life of vital plant equipment by using WRIGHT Water-Conditioning Chemicals.

Write for helpful information

Wright CHEMICALS

WRIGHT CHEMICAL CORPORATION

Specializing in Water Conditioning

GENERAL OFFICE AND LABORATORY

617 West Lake Street, Chicago 6, Illinois

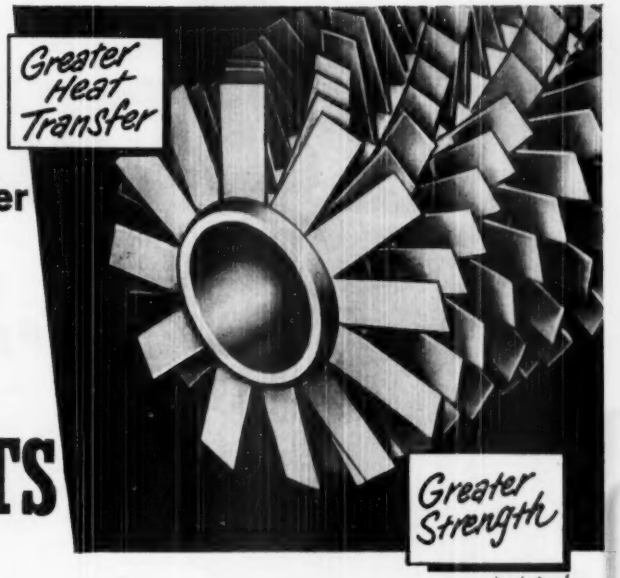
OFFICES IN PRINCIPAL CITIES

Sole Distributor of Nelson Chemical Proportioning Pumps

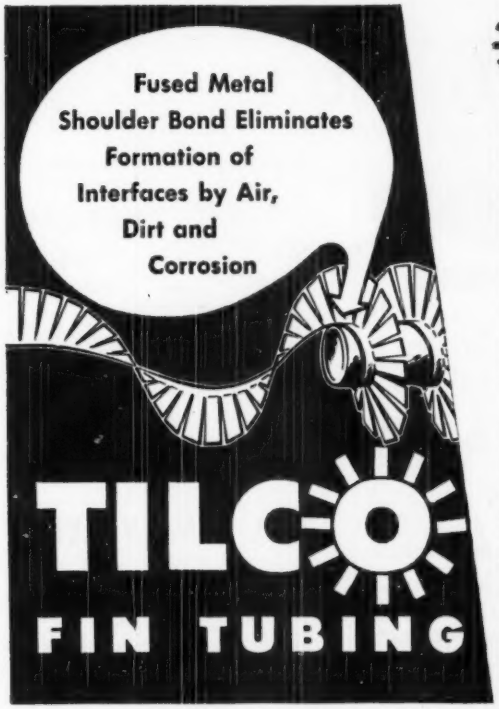
NOW!

Exclusive Fin-Shoulder Bonding

LOWERS STEAM COSTS



Only TILCO Strip Fin Tubing is SHOULDER BONDED by Welding



TILCO-FIN DIVISION
David E. Kennedy, Inc., Brooklyn, N. Y.

Fin tubing is the modern way to cut high steam costs. But now Tilco exclusive features can make your steam costs drop *even more.*

Here is why: Tilco is the only strip fin tubing *shoulder bonded* by resistance welding, soldering or brazing. Its full 1/8" shoulder makes possible (1) a fused metallic bond that eliminates 3 big causes of heat transfer loss...the formation of interfaces by air, dirt and corrosion, and (2) it imparts such increased strength to the fin bond that it will not break under any conceivable service condition.

Flexible Application

Tilco's own specially designed manufacturing equipment provides flexibility that can give you a "tailor made" installation. Wide range of metals...steel fin welded to steel tube ...stainless steel fin welded to stainless steel tube...steel fin welded to cupro-nickel tube and many others. Fin spacing from 2 to 16 fins per inch...fin heights from 1/8" to 2"...tube diameters from 1/2" to 6".

Mail the coupon today for a free sample or to have a representative call. You will learn why fin tubing reaches the most advanced point of effectiveness in "Shoulder Bonded" Tilco-Fin Tubing.

TILCO-FIN DIVISION, David E. Kennedy, Inc. Dept. A
58 Second Avenue, Brooklyn 15, N. Y.

I want to know more about "Shoulder Bonded" Tilco-Fin Tubing and how it will lower steam cost more than ordinary fin tubing. I understand there is no obligation.

1. *Have a representative call* ☐
2. *Send me a free sample* ☐ *Please Check*

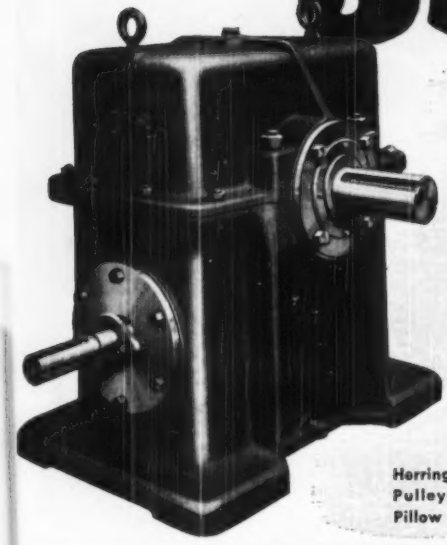
NAME_____

FIRM NAME_____

BUSINESS ADDRESS_____

CITY_____ STATE_____

Jones



WORM GEAR SPEED REDUCERS

A right angle unit built for heavy duty performance in any industry. The worm can be above or below the gear. Shafts are single or double extended for coupling connections or chain or gear drives.

They are built in ratios from 4 to 1 to 90 to 1 and in capacities from ¼ to 100 H.P.

Bulletin No. 68 covers selection tables and dimensions.

W. A. JONES FOUNDRY & MACHINE CO.
4423 W. Roosevelt Rd., Chicago 24, Ill.

Since 1890
Jones
In the Service of Industry

Herringbone — Worm — Spur — Gear Speed Reducers
Pulleys · Gears · V-Belt Sheaves · Anti-Friction
Pillow Blocks · Friction Clutches · Flexible Couplings

WHERE TO BUY

Featuring additional products specialties and services for power plants

CHIMNEYS

Industrial Waste Burners

AMERICAN CHIMNEY CORP.
141 Fourth Ave.
New York City

BRANCHES: BOSTON
PHILADELPHIA · BUFFALO
CLEVELAND · DETROIT

EMERGI-LITE

Automatic Safety Emergency Light

NO SEPARATE LINES TO RUN
NO INSTALLATION COST
REASONABLY PRICED
NO MAINTENANCE
AUTOMATIC
FOOL PROOF
PORTABLE
NO OIL
NO GAS
NO FUSS

THE LIGHT that NEVER FAILS

A MUST FOR HOTELS · HOSPITALS · BANKS · SCHOOLS · INDUSTRIAL PLANTS · RESTAURANTS · FARMS · CLUBS · POWER HOUSES · BOILER ROOMS · THEATRES

PREVENT ACCIDENTS
SAVE PROPERTY
CONTINUE BUSINESS

IT AUTOMATICALLY COMES ON, WHEN YOUR REGULAR LIGHT FAILS.

Manufactured in Canada — Dealer Inquiries Solicited

ALLIANCE ELECTRIC WORKS LTD.
161-163 BATES ROAD, MONTREAL • 600 BAY STREET, TORONTO

ERNST Liquid Level Gages

High and Low Alarm Columns
Split-Blend Water Gages
Sight Flow Indicators
Flat Glass Inserts

Sectional for Better Visibility

WRITE FOR BULLETINS

ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, N. J.

BIRCH Pump Valves

Best money saving investment in a power plant.

Has a one piece bronze metal body with two rubber composition inserts securely locked into the valve body. Seats screwed or pressed in. For Waterwks. BF, Vac, & Gen. Ser. pumps. Write for complete details.

BIRCH MANUFACTURING CO.
1523 Sedgwick St. Chicago 10, Ill.

HILL PUMP VALVES

SINCE 1909

● The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate.

Write for Bulletin

HILL PUMP VALVE CO.
2728 Elston Ave., Chicago 47, Ill.

WeldELLS®

Whatever you seek on that next welded piping job...*speed*...*economy*...piping for *extreme conditions*...piping to withstand *corrosion*...you will find the answer to it in piping welded the WeldELL way.

You will find the answer because the WeldELL line incorporates job-speeding, cost-cutting features that are combined in no other welding fitting.

You will find the answer because the WeldELL line expresses the best of all we have learned in fifty years of intensive specialization in forged fittings for designed piping and pressure vessels.

The WeldELL line also goes beyond all others in range of sizes, types, thicknesses and scope of materials. Form a good habit—the WeldELL habit. Your reward will be the deep-down satisfaction of using the best there is! Coupon brings catalog.

Taylor Spiral Pipe is again promptly available in a broad range of sizes and thicknesses. Coupon brings new Spiral Pipe Bulletin 493.

TF

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS, P.O. Box 485, Chicago 90, Ill.

Offices in all principal cities.

Eastern Plant: Carnegie, Pa. • *Western Plant:* Fontana, Calif.

☐ Please send new Catalog 484 covering welding fittings and forged steel flanges.

☐ Send new Bulletin 493 covering Taylor Spiral Pipe and related fittings.

NAME_____

POSITION_____

COMPANY_____

STREET ADDRESS_____

CITY_____ ZONE_____ STATE_____

501-0750 Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

PROFESSIONAL SERVICES

CONSULTING
CONSTRUCTION

DESIGN
PLANS

EXAMINATIONS
SURVEY • REPORTS

PATENTS
TRADE MARKS

BURNS & McDONNELL
Consulting and Designing Engineers
Kansas City, Mo. P. O. Box 7088
Cleveland, Ohio 1404 E. 9th St.

NO TIME TO EXPERIMENT . . .
So why not save time by calling in a specialist who knows the ground you are exploring?
POWER, meeting place of power men in all parts of the country, points the way to the solution of many power problems through its Professional Service Section.

SARGENT & LUNDY
Engineers
140 South Dearborn St. Chicago, Illinois

THE H. K. FERGUSON CO.
Industrial Engineers and Builders
POWER PLANT DEVELOPMENT, ENGINEERING AND CONSTRUCTION
The Ferguson Building, Cleveland, Ohio
Chicago • Houston • Los Angeles • New York City

J. E. SIRRINE COMPANY
Engineers
Power Plants — Consultations
Design — Reports
Water — Steam Utilization — Plans
Greenville, South Carolina

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Industrials and Utilities, Power Plant Design and Construction. Rehabilitation and Maintenance.
Steam — Diesel — Hydro — Sewage
Reports — Examinations — Laboratory
New York, Reading, Pa., Philadelphia
Houston, Washington

PAUL H. MORRISON
Water Consultant and Chemist
Referee and consulting—industrial wastes, water supplies, purification, pollution, feed and boiler water control.
Reagents, test kits, water-conditioning equipment.
— 25 years specialization —
Valencia, Penna.

STANLEY ENGINEERING COMPANY
Consulting Engineers
Power Plants
Steam - Diesel - Hydro
Design - Construction - Test - Valuation
Hershey Building, Muscatine, Ia.

THE KULJIAN CORPORATION
Engineers - Constructors
Power Plants and Industrial Projects
1200 N. Broad St., Philadelphia 21, Pa.
Washington, D. C. — St. Petersburg, Fla.
Calcutta—Rome—Caracas

FRED L. PEARSON
Reg. Mechanical & Electrical Engineer
Steam—Diesel Power Plants, Water Supply, Sewage disposal, Heating, Air Conditioning, Electrical distribution systems, Design Construction and Supervision.
204 Commerce Building, Detroit 26, Michigan

JOHN A STEVENS, INC.
Established 1909
Consulting Engineers
Power Plants — Paper Mills
Dye Houses — Surveys
Lowell, Massachusetts

LARAMORE AND DOUGLASS, INC.
CONSULTING ENGINEERS
POWER PLANTS
TRANSMISSION — DISTRIBUTION
DESIGN—REPORTS—APPRAISALS—RATES
79 East Adams Street, Chicago 3, Illinois

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design Engineers . . Purchasing . . Specialists in Financing, Accounting and Other Operations
231 So. La Salle St. Chicago 4

SYSKA & HENNESSY, INC.
Engineers
Consultation — Plans — Reports
Power Plants — Water Systems — Disposal Plants
144 East 39th Street
New York, New York

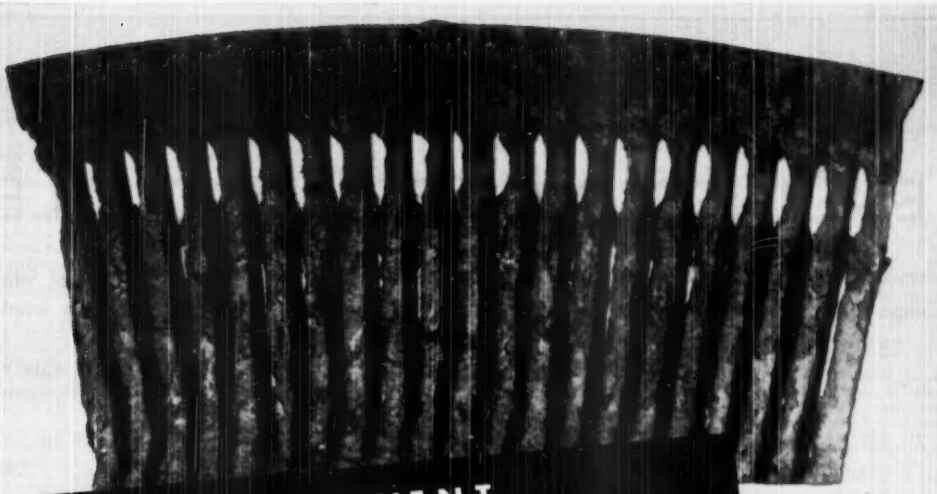
T. MASENG & ASSOCIATES, INC.
Engineers
Electrical, Design — Structural, Reports — Mechanical Rates
7 So. Dearborn, Chicago 3, Ill.

SANDERSON & PORTER
Engineers and Constructors
New York — Chicago
San Francisco — Los Angeles

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

THE CONSULTING ENGINEER

"By reason of special training, wide experience and tested ability, coupled with professional integrity, the consulting engineer brings to his client detached engineer and economic advice that rises above local limitations and encompasses the availability of all modern developments in the fields where he practices as an expert. His services, which do not replace but supplement and broaden those of regularly employed personnel, are justified on the ground that he saves his client more than he costs him."



PREVENT
ENCRUSTATION
OF VALUABLE EQUIPMENT

Unretouched photograph showing encrustation of turbine blade section.

USE DEARBORN POLYAMIDE ANTI-FOAM NO. 659

This section of turbine of a large generator was replaced because of blade fouling caused by improperly and inadequately treated steam boiler water.

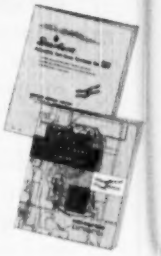
Dearborn Polyamide Anti-Foam No. 659 would have substantially lengthened the life of this costly part . . . would have eliminated the time devoted to repair of the generator.

If you use steam in your plant, it will pay you to investigate Polyamide Anti-Foams . . . an exclusive Dearborn development that produces purer steam—eliminates scale formation in feed lines, heaters and economizers—prevents carry-over of suspended or dissolved solids—conditions sludge—is compatible with other treatment.

Consult Dearborn, whatever your needs in water treatment. Serving industry since 1887.

DEARBORN CHEMICAL COMPANY
310 S. Michigan Ave. • Chicago 4, Ill.

TWO VALUABLE BOOKLETS
Write for copies



For information on Dearborn Polyamide Anti-Foams, write for Bulletin No. 5008. And for a complete description of Dearborn Industrial Water Treatment and Engineering Service, write for Bulletin No. 5000. The coupon is for your convenience.

Dearborn Chemical Company
Dept. PO, 310 South Michigan Ave.,
Chicago 4, Ill.

Gentlemen: Please send:

( ) Bulletin No. 5008—Dearborn Polyamide Anti-Foams

( ) Bulletin No. 5000—Dearborn Industrial Water Treatment and Engineering Service

Name.....

Company.....

Position.....

Address.....

City.....State.....

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

WATER TREATMENT AND SOFTENING COMPOUNDS · COMPLETE ENGINEERING SERVICE · NO-OX-ID RUST PREVENTIVES

For Your

ENGINEERING REFERENCE FILE

POWER offers the following reprints of special editorial sections, covering subjects of vital importance to power men everywhere. Use the coupon below to order those you want.

Cost Postpaid

1. LICENSE REQUIREMENTS — 32-page survey by OPERATING ENGINEER summarizes stationary-engineer license laws of: (1) U. S. states and cities over 50,000 population (2) Canadian provinces, and (3) U. S. merchant marine 25c
   (For orders of 10 to 100 copies, 20c; 100 copies or more, 15c)

2. HIGH-TEMPERATURE METALS—16 pages reviewing for power engineers the basic properties of metals and alloys, the effects of temperature, the development of the new "super alloys" and the problems of designing equipment for high temperature service 20c

3. BUILDING HEATING — 20 pages covering fundamentals of heating, hookups and equipment for steam, hot-water and warm-air heating systems 25c

4. CIRCUIT PROTECTION—16 pages covering devices for over-current protection in circuits of 600 volts and below. Describes and shows application of fuses, circuit breakers and associated thermal and magnetic devices ... 20c

5. INDUSTRIAL POWER CLUTCHES—16-page special section describes applications, construction, operation, and characteristics of manually and automatically applied power takeoffs, line-shift clutches and clutch couplings, including magnetic and hydraulic drives 20c

Cost Postpaid

6. MODERN DIESEL ENGINES — 50 Years of Progress. 32 pages. Explains how diesels work, auxiliaries, construction, inlet air, gas, supercharging, injection, lubrication, etc. 50c

7. FLEXIBLE COUPLINGS — 16-page special section tells what flexible couplings do and how they are selected, describes various types 20c

8. COMBUSTION CONTROL — 36 pages covering what automatic controls do and how they do it, plus detailed explanations of current types of control systems and how they are applied 45c

MAIL THIS COUPON

Editor, POWER, 330 West 42nd Street, New York, 18, N. Y.

Please send me ..... copies each of the reprints represented by the number circled below. I enclose check ( ), money order ( ) for $ .....

1 2 3 4 5 6 7 8

Name .....

Address .....

City ..... Zone No. .....

State 7/50P

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE
(Not available for equipment advertising)
$1.20 a line, minimum 4 lines. To figure advance payment, count 5 average words as a line.
INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of rate, payable in advance.
PROPOSALS, $1.20 a line an insertion.

INFORMATION
BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 1 line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:
The advertising rate is $10.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns — 30 inches—to a page.

NEW ADVERTISEMENTS received by July 7 at the New York Office, 330 W. 42 St., N. Y. 18, will appear in the August issue, subject to limitation of space available.

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42 St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

WANTED: POWER Plant Superintendent for a large industrial plant in Maryland. Applicant must be under 40 years of age, possess the degree of B.S. in M.E. from an accredited college, and have had at least 10 years' experience in the various phases of power plant operation and maintenance. He must be familiar with powered coal and stoker-fired boilers, and steam turbine and switchboard operation. Refrigeration plant experience is also desirable. Salary open. The Power Plant which he will superintend has an approximate steaming capacity of 500,000 pounds per hour. About half of this capacity is utilized for electrical current generation and the rest, including by-product steam from the turbine, is utilized for process requirements. P-6405, Power.

EMPLOYMENT SERVICES

SALARIED PERSONNEL $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept G, 241 Orange St., New Haven, Conn.

Engineers — Executives — Technical Men
Salaried Positions, $4,000 to $30,000
This Confidential service for men who desire a new connection, will develop and conduct preliminary negotiations without risk to present position. Send name and address for details.
TOMSETT ASSOCIATES
1205-2 Berger Bldg., Pittsburgh 19, Pa.

When Writing Your Ad

Provide an indexing or subject word.

Write it as the first word of your ad.

If it is a Position Wanted or Position Vacant ad, make the first word the kind of position sought or offered.

This will assure proper classification in the column.

The right is reserved to reject, revise or properly classify all Want Advertisements.

Proper Classification increases the possibility of Prompt Returns

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (40 years recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Hixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

CHIEF ENGINEER ex-Navy, 49, N. J. Gold seal. Will take full responsibility proper operation and maintenance H.P. steam plant 160,000 lb./hr.-fuel oil-pulversizers, turbines, refrigeration, etc. Accept less responsibility in suitable plants. Present salary $5,500. PW-6932, Power.

OPERATION-MAINTENANCE Supt. or Asst. Twenty years experience with intimate knowledge of power plant and industrial steam and elec. generation and distribution. Also maintenance in large chemical process plant. Excellent personnel training and handling record. Some design and modernization. Available at once. PW-6983, Power.

POWER ENGINEER—Twenty-five years experience, operation and maintenance of modern power plants, electrical equipment, refrigeration, air conditioning and water filtration plants. Fifteen years high pressure plant, some construction, with a utility, industrial plant or municipality. Registered engineer, gold seal licensed power plant operator. Will relocate or travel. PW-6662, Power.

POWER PLANT Supervisor, seven years of power plant operation and maintenance experience. Also some refrigeration. Age 29. PW-6958, Power.

SELLING OPPORTUNITY WANTED

NEW YORK REPRESENTATIVE — Graduate Mechanical Engineer, 11 years experience in sales, maintenance and factory management desires to represent machinery or equipment manufacturer in New York area. Have available New York office and staff with experience in handling export shipments. Presently employed as Ass't Treasurer of New York concern. Write to D. B. Blackburn, Box 394, Sparta, New Jersey.

LEFAX POCKET SIZE TECHNICAL DATA BOOKS $1. EACH

Printed on loose leaf, six hole, 6¾" x 3⅜" bond paper each book contains about 140 pages of technical data, presenting condensed, accurate and essential data for the student, engineer, technical worker and business man.

Architecture	Metals	Relays, Meters
Home Heating	Gen'l Chemistry	Hydraulics
Illumination	Reinf. Concrete	Surveying
Electrician's Data	Building Constr.	Mech. Drawing
Builder's Data	Radio	Machine Design
Lumber Data	Television & FM	Machinist's Data
Air Conditioning	Electricity, AC	Piping Data
General Math.	Electricity, DC	Surveying Data
Math. Tables	AC Motors and Generators	Trig.-Log Tables
Physics	Transformers,	Metallurgy
Chemical Tables		Analytic

Write for FREE Catalogs (over 2000 listings). See for yourself how helpful LEFAX can be to you. Send $1 for each book, or $5 for any six books listed.
LEFAX DEPT. PO 3 PHILADELPHIA 7, PA.

SALES ENGINEER

Now it is possible to PREVENT formations and accumulations of Slag and Fireside deposits on boilers and furnaces. Our new System causes the complete combustion of the Combustibles in the furnace area. The Ash is deposited in the Ash Zone instead of entering the tube bank or building up, on the walls. Smoke Control is an accomplished fact. This System was developed through long research by a Nationally known, well established Manufacturer.

The importance of this new development to Industry offers an exceptional opportunity to Sales Engineers throughout the East, South and Midwest, who have Combustion experience in the Industrial and Utility Power Plant fields.

State experience and qualifications in reply.

SW-6533, POWER
520 N. Michigan Ave., Chicago 11, Ill.

WANTED
POWERHOUSE OPERATORS

An American Oil Company operating in South America will welcome applications from well qualified powerhouse operators.
Minimum five years' experience in public utility or large industrial powerhouse. Should be experienced in operation of high pressure boilers, steam turbines, evaporator plants, switchboards, and auxiliary equipment.
These are regular staff jobs offering retirement plans and other benefits.

Write giving age, education, marital status, and detailed experience resume.

Box 308-V, Radio City Station
New York 19, New York

ENGINEER
DEVELOPMENT
INSTRUMENT FIELD

. . . for development engineering on automatic combustion control equipment. Prefer young mechanical or electrical engineer with several years' experience in development work on measuring instruments and/or controllers. Knowledge of steam power plant equipment desirable. *Write giving full particulars.*

LEEDS & NORTHRUP CO.
4901 Stenton Ave., Philadelphia 44, Pa.

ASSISTANT PLANT ENGINEER

With at least 3 years experience in industrial plant Maintenance; emphasis on electrical maintenance, M.E. or E.E. degree required. Give full details experience, education, age, salary in first letter.

P-6926, POWER
520 N. Michigan Ave., Chicago 11, Ill.

Additional Positions Vacant ad on the following page.

WAGNER

CERTIFIED REBUILT

ELECTRIC MOTORS & GENERATORS

Backed by 44 Years of Quality & Service

M-G SETS

KW	Mfr	Input V	Output V
500	G.E.*	2300/4000 AC	600 DC
500	G.E.*	2300 AC	250 DC
300	Allis Ch.*	220/440 AC	250 DC
300	Gen. Elec.	440/25 cy.	275 DC
200	Ridgeway*	2300/4000 AC	550 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Reliance*	220/440 AC	250 DC
150	Gen. Elec.	220/440 AC	125/250 DC
150	Burke*	250/440 AC	250 AC
105	Century b.b.	220/440 AC	70 DC
100	Allis Ch.	220/440 AC	125/250 DC
100	Allis Ch.	2200 AC	250 DC
75	Gen. Elec. (3)	220/440 AC	125 DC
75	Cr. Wh. b.b. (2)	220/440 AC	250 DC
75	Star* b.b. NEW	220/440 AC	50 DC
50	Whse.	220/440 AC	250 DC
50	Gen. Elec. (2)	220/440 AC	125 DC

*Hyn. motor drive.

D. C. MOTORS

HP	Mfr	Type	Volts	Speed
200	Reliance	1970	230	575/750
150	Whse.	SK201	230	300/900
150	Cr. Wheeler b.b.	52H	230	1200
150	Cr. Wheeler b.b.	TEFC	230	800
100	Whse.	SK181	230	450/900
100	Gen. Elec.	C	230	575/1000
100	Gen. Elec.	RC36	115	1150
75	Allis Ch.	E-149	230	500
75	Northw'n	K29	230	1750
75	Cr. Wh. NEW b.b.	CMC-HH	230	1150
75	Century NEW	DN	230	850
60	Century NEW	DN	230	1150
60	Century NEW	DN	230	1750
50	Cr. Wheeler	FH	230	1750
50	Gen. Elec. b.b.	CDM	115	1150
40/60	Whse. (2)	SK 70	230	500/1000
40	Cr. Wheeler	EH	230	1750
40	Century (2) NEW	DN	230	1150
40	Whse. (2)	SK130	230	950
35/50	Gen. Elec.	CD123	230	575/1150
30	Reliance b.b. (3)	230T	230	850
30	Whse.	SK93	230	1750

- EXPLOSION PROOF MOTORS—
- GEARHEAD MOTORS, AC & DC.
- FREQUENCY CHANGERS.
- CIRCUIT BREAKERS, AC & DC.

D. C. GENERATORS

HP	Mfr	Type	Volts	Speed
300	Gen. Elec. 1 brg.	DMC	275	720
200	Reliance	1970T	250	720
150	Cr. Wheeler b.b.	TEFC	250	1200
125	Cr. Wheeler b.b.	52H	250	1200
165	Century b.b.	1500 assp.	70	1200
100	Gen. Elec.	C	230	850
100	Allis Ch. 3 wire	MCW	120/240	1200
100	Gen. Elec.	DLC	250	675
75	Cr. Wh. NEW b.b.	HH	250	1450
75	Allis Ch.	B	250	750
75	Gen. Elec. (2)	RC36	125	1200
50	Whse.	SK	250	1200
50	Gen. Elec. b.b.	CDM	125	1450

A. C. MOTORS—25 CYCLE

HP	Mfr	Type	Volts	Speed
300	Gen. Elec.	I-M	440	750
150	Whse.	HF	440	900
150	Gen. Elec.	IK-16	440	750
100	Gen. Elec.	I-K	440	500
50	Gen. Elec. Int.	MTC5337	440	750
50	Gen. Elec.	I-K	440	750
50	Gen. Elec.	KT339	440	1500
40	Gen. Elec.	KT343	440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
375	Gen. Elec.	ATB7567	240/480	1200
300	Gen. Elec.	ATB	600	720
250	Whse.	G	2400/480	600
225	Gen. Elec.	ATB	240/480	600
187	Gen. Elec. (2)	ATB	240/480	900
156	Elec. Machy.	3 brg.	240/480	514
125	Gen. Elec.	ATB	240/480	720
125	Gen. Elec.	ATB	240/480	900
100	Gen. Elec.	ATB	2300	900

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	500	Allis Ch.	ANY	450
1—	400	Gen. Elec. 2300V.	IM-EB	1800
2—	300	Allis Ch. 2200V.	ANY	720
1—	300	Gen. Elec. 2200V.	I-M	1800
1—	250	Allis Ch. 2200V.	ANY	514
2—	200	Gen. Elec. 2200V.	I-M-16	600
1—	200	Gen. Elec.	I-M	360
1—	200	Allis Ch. 2200V.	ANY	720
2—	150	Gen. Elec. 2200V.	I-M-16	900
1—	150	G.E. 2200/4000V.	I-M	1200
1—	150	Allis Ch.	ANY	600
1—	150	Gen. Elec.	I-M-17	450
1—	125	Gen. Elec.	IM-15	720
1—	100	Gen. Elec.	MT356	900
1—	100	Gen. Elec.	I-M	720
1—	100	Allis Ch.	ANY	1800
1—	75	Howell	SH443	1800
1—	75	Cont. b.b. NEW	SN584	1200
1—	75	Gen. Elec.	I-M-E13	1200
2—	75	Gen. Elec.	I-M-14	720
1—	75	Gen. Elec. int. duty	MTC5342	900
1—	75	Gen. Elec.	MT558	600
1—	75	G.E. 2200V.	MT556	720
1—	50	Allis Ch.	ANY	900
1—	50	Howell	SH437	1200
1—	50	Gen. Elec. int	ITC5013	600
1—	50	Gen. Elec.	I-M	720
1—	40	Gen. Elec. int	NTC5526	900
2—	10	Gen. Elec.	MT536	1200

A. C. MOTORS—SYNCHRONOUS

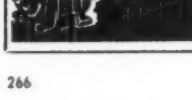
HP	Mfr	Type	Volts	Speed
600	Gen. Elec. (2)	TS	2200	514
400	Gen. Elec. .8PF	TS	220/440	1200
300	Whse.	G	2300/440	600
300	Gen. Elec.	ATI	440	720
275	Gen. Elec. (2)	ATI	2300	450
220	G.E. 3 brg. .8PF	ATI	220/440	900
200	GE. .8PF	ATI	220/440	900
190	El. Machy.	3 brg	220/440	514
175	Gen. Elec. (2)	ATI	2200	450
150	Gen. Elec.	ATI	220/440	360
150	Gen. Elec. (2)	ATI	220/440	720
125	Gen. Elec.	TS	2200	900
100	American b.b.	YGH	220/440	900

A. C. MOTORS—SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
1—	400	Whse. 2200V.	CS	1800
1—	250	Gen. Elec.	FT549AZ	3600
1—	250	Gen. Elec.	FT549	3600
1—	250	Whse.	CS954A	720
1—	200	Whse. b.b. NEW	CS875	1800
1—	200	Allis Ch.	AN	1200
1—	150	Gen. Elec. TEFC b.b.	K6333S	1200
1—	150	Gen. Elec.	I-K-16	600
1—	150	Reliance b.b. NEW	B6085	1200
2—	150	Gen. Elec.	KF557	1200
1—	150	Gen. Elec. TEFC b.b.	K6325	720
1—	150	Gen. Elec.	IK-R12A	1800
1—	150	Gen. Elec. 2200V	K5658	1800
1—	125	Reliance b.b. NEW	C5085	1200
1—	125	Allis Ch. 2200V.	AN	1200
1—	125	Gen. Elec.	I-K-16	450
1—	125	Cont. 2200V. b.b.	SC	1800
2—	125	Rel. TEFC NEW	B6085	1800
2—	125	F.M. 2200V. vertical	UH-16D	1200
5—	100	Allis Ch. 2200V.	AR226	1200
1—	100	Reliance b.b. NEW	C5085	900
1—	100	Rel. TEFC NEW	C5085	1200
1—	100	Gen. Elec. b.b. NEW	K5048	1800
1—	100	Cont. TEFC	NFC982	1200
1—	100	Gen. Elec.	I-K-J	720
2—	75	Gen. Elec.	I-K	600
1—	75	Reliance b.b. NEW	C5084	900
1—	75	Reliance TEFC NEW	C5084	1200
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen. Elec.	KT328Y	3600
2—	75	Reliance b.b. NEW	C505	1200
1—	60	Gen. Elec.	KT552	720
2—	60	Reliance b.b. NEW	B504	1800
2—	60	Reliance TEFC NEW	C505	1200
2—	60	Reliance b.b. NEW	C504	1200
2—	60	Whse. H.T.	C8504	1800
1—	60	Wagner b.b.	RP444	3600
1—	50	Allis Ch. b.b.	ARX445	1800
1—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
1—	50	Gen. Elec.	KT342	900
1—	50	Whse. hislip	WL407	900
1—	50	Whse. b.b.	C8504	1200
2—	50	Gen. Elec.	KT352	600

QUICK SHIPMENT FROM STOCK — LOW PRICES — FULL GUARANTEE



Arthur Wagner Co.

1435 W. RANDOLPH ST. MO nroe 6-1409 CHICAGO 7, ILLINOIS

POWER PLANT PERSONNEL

An east coast utility now constructing a new high-pressure pulverized fuel generating station, the first two units of which will have a capacity of 132,000 K.W., will accept applications for employment from qualified persons for the following positions. These positions will be available in the fall.

SHIFT SUPERVISORS

To take full charge of shift operation. Must be thoroughly conversant with all phases of modern high-pressure pulverized fuel power plant operation, both electrical and mechanical. Must have previous supervisory experience in power plant operation.

CHIEF OPERATOR

Responsible for the operation of two steam-electric generating units from a fully centralized control room. Will be required to direct other operators in the performance of their duties and operate the plant from the control room. Must have previous experience as an operator of pulverized fuel boilers, hydrogen-cooled turbine generators, high voltage switchboards, condensers, boiler feed pumps and all related auxiliaries.

ASSISTANT CHIEF OPERATOR

Will be required to assist the Chief Operator in directing the operation of, and operating from the centralized control room all equipment such as pulverized fuel boilers, hydrogen-cooled turbine generators, switchboards, condensers, boiler feed pumps and all related auxiliaries.

MAINTENANCE FOREMAN

Must have good background of experience and be able to direct the maintenance of all power plant equipment, such as boilers, turbines, pulverizers, pumps, fans, air compressors, coal handling, machine shop, etc. Must have good mechanical ability and be able to take full charge of maintenance crew under the direction of the master mechanic. This job to be filled immediately.

INSTRUMENT MECHANICS

Previous experience on power plant instrument work essential. Must have a good working knowledge of and be able to service and repair such equipment as automatic combustion controls, flow meters, temperature recorders, gages, pH controllers and boiler meters. Must have a good understanding of electrical circuits as well as mechanical devices.

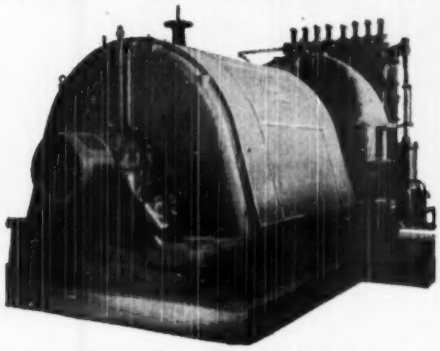
Job is centrally located near excellent residential community, good working conditions, forty-hour week (paid vacations, insurance, sick pay and retirement plan). All personnel selected for employment will be given complete job training at full pay to familiarize them with this particular installation before assuming their regular duties.

Include complete resume of experience and qualifications in first letter, together with recent photograph. All applications will be treated confidentially.

P-6897, POWER
330 W. 42nd St., New York 18, N. Y.

6250-KVA G. E. TURBINE-GENERATOR

A VERY HIGH GRADE MACHINE



SEND FOR BULLETIN NO. 415: CONTAINS SPECIFICATIONS.

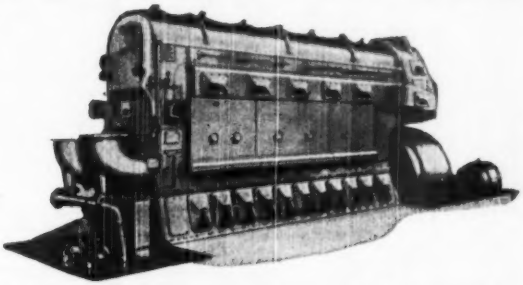
Above 6250-KVA., General Electric, is in A1 Condition. Complete, 200#-psig, 2300/4160-v, 3600-RPM., with 7000 sq. ft. Condenser with Auxiliaries.

OTHER TURBO-GENERATORS IN OUR STOCK

6250-KVA., G.E., 2300/4160v. Cond.
4375-KVA., G.E., Rebuilt: New Coils
3125-KVA., G.E., Complete, 250#
3125-KVA., West., 250#, 2300v. Cond.
2500-KVA., West., Non-C., 250# (2)
2500-KVA., G.E., 150#, Cond. 2300v.
1875-KVA., G.E., 250-psi., No. 1 unit
1875-KVA., Allis-C., Cond., 200#, 2300v.
1563-KVA., G.E., 200-psi, Non-C., 75/25-BP
1563-KVA., G.E., 225-psi. Cond., 2300v.
937-KVA., G.E., 150-psi. Non-C., 480v., 15-BP
937-KVA., Allis-C., Cond., 480v.
937-KVA., G.E., Cond., Rebuilt
625-KVA., West., Non-C., 300#-psi, 480v., 15/25-BP
625-KVA., G.E., Cond., 200-psi, 480v.
625-KVA. (2), G.E., Non-C., 480v., 150#, 15/25-BP
625-KVA. (2), DeLaval-Allis, 125#, 480v., 15/25-BP

COMPLETE DATA ON REQUEST, PLEASE SEND SPECIFICATIONS FOR ANY ITEM WANTED NOT LISTED

WE CARRY A LARGE STOCK OF DIESEL ENGINES, ETC.



BULLETIN 320 CONTAINS SPECIFICATIONS. SEND FOR IT TODAY.

Above Cut Shows a 1600-HP. Fairbanks-Morse Latest Model 38D8 1/8 Opposed Piston Diesel Engine, with New (never used) A.C. 3/60/2300/4160-v. Generator with Direct Connected Exciter Switchboard, Etc.

SPECIALLY ADAPTED FOR MUNICIPAL-ALL STATIONARY INSTALLATIONS

A FEW OTHER DIESEL POWER UNITS IN OUR STOCK:

6—Hamiltons, 1600-HP., 720-RPM., with West. Reversing Reduction Gears: SAME AS NEW; 15—Baldwin-Westinghouse 300-KW, DC., 240-v., 400-RPM.; 4—GM. Model 3-268-A, 100-KW, 4—FM. OP., 1200-HP., 720-RPM., Engines, 8-cyl. Nearly New. AND MANY OTHERS. Write Us, Giving Specifications.

Telephones
Woodward 1-1340
Woodward 1-1341
Woodward 1-6038

CHARLES WEAVER

4145 PENOBSCOT BLDG.
DETROIT 26, MICH.

OUR SLOGAN
Good Equipment
Immediate Deliveries
Right Prices

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

WRITE FOR NEW STOCK LIST No. 1622

VARIABLE VOLTAGE DRIVES

40 HP Reliance Variable Voltage Drives, each Consisting of:
1—40 KW 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing log forward, log reverse, run, fast, slow, and stop, and motor operated field rheostat.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	H.P.	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5201
2	10	1140	440	West.	HF-7A
2	10	870	220	G.E.	HI-11
3	11‡	820	550	G.E.	ITC-5008
2	15	1150	440	West.	CW-464C
2	15	870	220	West.	CW-646
1	18	680	440	West.	MW-316
1	20	860	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	350	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	865	440	West.	CW-646
1	30	350	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
3	35	600	440	F-M	HV-H16A
2	40	885	2200	Al.Ch.	ARY-223C
1	40	560	440	G.E.	MT-346
2	50	1150	440	G.E.	M-536
1	50	860	440	West.	HF-12A
1	80	570	440	G.E.	MT-552
1	53‡	550	220	G.E.	IQC-5013 ***
1	60	685	440	West.	CW-788
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW-938
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTP-549
1	175	595	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	495	2200	G.E.	IM-17A
3	300	900	140	G.E.	IM-17
3	300	880	2200	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-E15A
2	350	880	2300	G.E.	IM-17A
1	400	595	550	West.	CW
1	600	1770	440	G.E.	IM-E15C
1	650**	360	440	G.E.	MT-442Y
1	700	735	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts.
‡ Intermittent rating. *** 2 phase.
** New. ‡‡ 25 cycle.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding and Direct Connected Exciter.

Quan.	KVA	RPM	Make	Volts
4	18.7	1800	Columbia	240/120
5	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
10	¾	850	Reliance	Y-23T
25	¾	850	West.	SK-830
1	7½	1150	G.E.	CDM-65
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al.Ch.	EB-80
2	10	850	West.	SK-83
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
5	15	825	West.	SK-96
1	20	1750	L.A.	ONA-L851
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1100	G.E.	RC-12
1	40	1750	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	HC-16
1	60	1750/1310	West.	SK-143
1	150	700	Al.Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
2	10/15	600/2400	Reliance	T-92T
1	12½	250/340	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	400/1600	Reliance	T-23-T
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/2500	West.	SK-143
1	40/50	400/1200	Reliance	T-4611
1	75	500/1500	Cr.Wh	CCM
1	75	375/750	Cr.Wh	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	320/500	West.	SK-220
2	375	350/500	G.E.	MPC

**New.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-R (P
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1760	220	G.E.	K-365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	40	3565	440	G.E.	KF-4058

Splashproof, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
23	½	1750	440	L.A.	FS-254
1	½	1735	220	G.E.	K-254
1	½	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
3	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	125	1770	440	L.A.	FX-1078Y
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335
1	200	885	440	L.A.	FS-1378

Open Type Motors

Qn.	HP	Speed	Volts	Make	Type
1	15	3485	220	Reliance	AA-13247
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RPT-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	KT-312
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRH-356***
2	25**	875	440	Master	PR-405
2	25	575	440	G.E.	KT-542
3	30	3550	550	G.E.	K-3648
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3548	220	G.E.	KF-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP5-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-652C
1	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-552
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	560	2200	West.	CS-930
1	100	495	2200	Al.Ch.	AN
2	125	435	440	Al.Ch.	AR
2	125	400	2300	G.E.	I-17-FR
1	200	580	550‡‡	G.E.	KT-5668
2	300	587	2200	West.	CS-39A
1	400	1165	2200	G.E.	IK-E15B
1	500	1200	440	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

220 volt motors can be reconnected for 440 volts
**New. ***2 Phase. ‡‡Reconnectable for 440 volts

G. E. DYNAMOMETERS

1 ea. 7½ HP with Control and Dial Scale
(Write for Complete Specifications)

Qn.	HP	DC Volts	RPM	Type
1	50/75	250	1650/4000	TLC-20
1	200	250	1200	C

MOTOR GENERATOR SETS

125 and 250 Volts D. C.
(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
2	Cont.	1750	125	220/440
7.5**	West.	1455	125	380/220§
10	West.	1760	125	220/440
10	West.	1450	125	220/440†
10	West.	1150	250	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440§
16	West.	1750	125	2200/440
20	West.	1750	250	220/440
25	G.E.	1800	250	220/440
25	G.E.	1200	125	220/440
30	G.E.	1800	250	220/440
30	Al.Ch.	1750	125	220/440
50	West.	1750	250	220/440
50	G.E.	720	125	220/440†
75	G.E.*	1200	125	220/440
75	G.E.	1200	250	2300/440
100	Columbia*	1200	250	2300/440
150	West.*	1200	250	2300/440

Note: 3KW, 5KW & 7.5KW, 250 V Sets Available
**New. *Synch. Motor Driv n. §50 Cy. †25 Cy.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVE. CLEVELAND 11, OHIO

COMPRESSORS
VACUUM PUMPS
"AMERICAN" Rebuilts

Since 1902

DISCRIMINATELY DIFFERENT

SAVE 40%-60%

— SALE OR RENT —

STATIONARY — PORTABLE

PORTABLE

60 CFM Chicago, Gas, Starter, Hose Reel, 2 Pneumatics. Rental or Rental Purchase.

American Air Compressor Corp.
47th & Dell Ave., North Bergen, N. J.

The Stephen A. Douglass Co.

have condensing type
TURBO-GENERATORS
in complete units,

Capacities 500 KW to 10,000 KW

CAPITAL COST LOW
Current cost per KW LOW

? *On What Capacity Unit Shall We Quote You* ?

Can Supply Boilers Also.

630 Fort Washington Ave., N. Y. 33, N. Y.

DIESEL ELECTRIC GENERATORS

1—G.E. (NEW) 750 KW, 2400/480 Volts, 3/60, 720 RPM.
2—Crocker Wheeler (NEW) 600 KW, 2300/460/3/60/720.
2—Westinghouse (NEW) 500 KW, 2400/480/3/60/720.

Each direct connected to General Motors Diesel Engine and complete with new, modern Switchboard.

SEE THESE UNITS OPERATE UNDER FULL LOAD IN OUR PLANT.

SUNDFELT EQUIPMENT CO., INC.
220 Hudson Street Seattle 8, Wash.

CRANE MOTORS

(5) GE MD107 ..... $1,000.00 EA.
(4) GE CO1807 ..... 250.00 EA.

WINSTON MACHINERY CO., INC.
517 South Delaware St., Indianapolis 4, Ind.

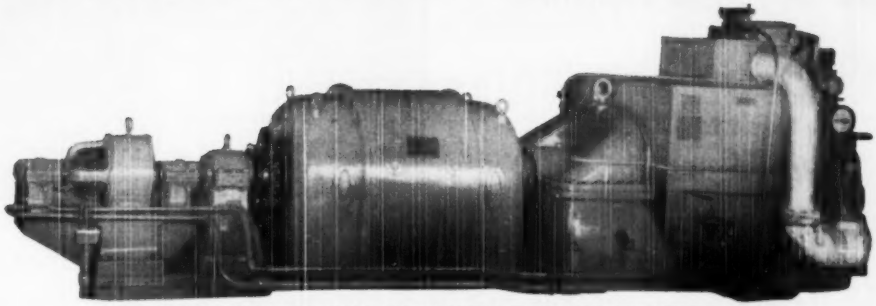
NEW and REBUILT
MOTORS
GENERATORS
TRANSFORMERS
1 to 1500 H. P.
ELECTRIC EQUIPMENT CO.
ROCHESTER 1, NEW YORK
Write For Free 1950 Catalog

Generator Voltage Regulators
New — Used — Sold — Exchanged — Rebuilt

Westinghouse Silverstat General Electric GDA Allis Chalmers Rocking contact for A.C. and D.C. generators all sizes for quick delivery.

WESTERN REGULATOR EXCHANGE
1730 Wazee St. Denver 2, Colo.

POWER PLANT MACHINERY



1250 KVA WESTINGHOUSE AUTOMATIC EXTRACTION TURBO UNIT

1250 KVA Westinghouse generator, 3 phase, 60 cycle, 480 volts, direct connected to Westinghouse automatic extraction condensing turbine, 150-200# steam pressure, 100° superheat, 0-10# extraction pressure, 3600 RPM. Equipped with direct connected exciter, switchboard, surface condenser and auxiliaries.

TURBINE GENERATOR UNITS—3 phase 60 cycle

6250 KVA Allis condensing, 200# steam, 2400/4160 volts.

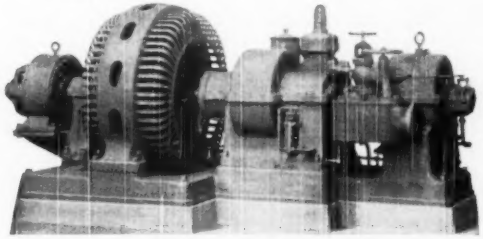
5000 KVA G.E. non-condensing, 600# steam, 50# exhaust, 150# extraction, 13,800/6900/4000 volts.

3125 KVA (New) G.E. condensing, 600# steam, 13800/4150/2300/480 volts.

2500 KVA (New) G.E. automatic extraction, 600/400# steam, 100/150# extraction, 4150/2300/480 volts.

1875 KVA Allis condensing 200# steam, 2300 volts.

1250 KVA Westg., condensing, 150/200# steam, 240/480 volts.



625 KVA WESTINGHOUSE NON-CONDENSING TURBO UNIT

625 KVA Westinghouse generator, 3 phase, 60 cycle, 480 volts, 900 RPM, direct connected through reduction gear to Westinghouse non-condensing turbine 150-200# steam pressure, 0-100° superheat, 0-10# back pressure, 6000 RPM. Equipped with direct connected exciter and switchboard.

SPECIAL
HIGH FREQUENCY TURBO UNITS

2000 KW (3) General Electric generators, 3 phase, 120/180/240 cycles, 2300/4150 volts, direct connected to General Electric automatic extraction condensing turbines, 10 stage, 600/400# steam pressure, 750° FTT, 100-150# extraction.

Brand New — Still in Original Crates

UNIFLOW UNITS—3 phase 60 cycle

750 KVA Ames Vertical, 150# steam, 5# exhaust, 4000/2300/480 volts.

625 KVA Skinner, 150# steam, 5# exhaust, 240/480 volts.

500 KVA Skinner, 150# steam, 5# exhaust, 2300/480 volts.

375 KVA Skinner, 150# steam, 5# exhaust, 2300/480 volts.

250 KVA Skinner, 150# steam, 5# exhaust, 480 volts.

250 KVA Ames Vertical, 150# steam, 5# exhaust, 480 volts.

188 KVA Ames Vertical, 150# steam, 5# exhaust, 480 volts.

175 KVA Skinner, 150# steam, 5# exhaust, 240 volts.

Send Us Your Inquiries for Power Plant Machinery

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. **Telephone: MAin 1-9514** **CLEVELAND 14, OHIO**

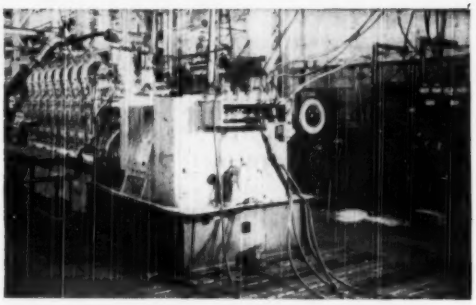
DIESEL POWER

AT 40% TO 60% SAVINGS

EACH ENGINE "REMANUFACTURED"
AND "FULL-LOAD TESTED"
PRIOR TO SHIPMENT

INSPECTION INVITED

ALL EQUIPMENT OFFERED WITH ONE YEAR GUARANTEE



VIEW OF ENGINE TEST STAND FACILITIES AT OUR PLANT IN SAUSALITO (S.F.) CALIF. ALL ENGINE TESTING CONFORMS TO DIESEL MANUFACTURERS' STANDARD METHODS.

A PARTIAL LIST OF OUR INVENTORY

KVA	MAKE	MODEL	HP	RPM	KVA	MAKE	MODEL	HP	RPM
1875	Fairbanks Morse	33E16	2000	300	312.5	Clark	MD-4	375	327
1420	Fairbanks Morse	38D	1600	720	300	Fairbanks Morse	YVA	360	257
1250	General Motors	16-278A	1600	720	250	General Motors	8-268A	350	1200
1000	General Motors	12-278A	1200	720	237	Ingersoll-Rand	S	255	600
937.5	General Motors	12-567	1080	720	200	Buckeye	80	240	600
625	Alco	6-12½x13T	750	600	156	Buckeye	E	190	400
425	Baldwin	VO	510	450	125	General Motors	3-268A	150	1200
400	Buckeye	80	480	600	121	Fairbanks Morse	32E14	140	300
375	Enterprise	DSG-6	450	450	75	General Motors	6-71	90	1200
330	Superior	KNA	396	514	62.5	Int'l Harvester	UD-18	76	1200
312.5	General Motors	8-268A	450	1200	50	General Motors	4-71	60	1200

A. G. SCHOONMAKER COMPANY, INC.

52 CHURCH STREET, NEW YORK 7, N. Y.

SHOPS AND WAREHOUSE: JERSEY CITY, N. J. AND SAUSALITO (S.F.) CALIFORNIA

NORTHERN METAL CO. — MACHINERY at REDUCED PRICES

DIESEL GENERATORS

100 K.W. Allis Chalmers. 1944. 3/60/120/450.
Exciter: 3 K.W. 120 V. D.C.
Diesel Engine: Lorimer. Model F5SS. 150 H.P. 7½"x9½".
5 cylinder, with electric starting motor.

MOTORS

Westinghouse, 1944. Synchronous—Induction.
60 Pole, 3300 S.H.P. 3 Phase. 82.5 Cycles. 2200 Volts.
165 R.P.M. Power Factor 100%.
Exciter: 125 Volts D.C. Load Factor 100%. 1944.

BOILERS

WATER TUBE. Babcock & Wilcox. 1945. 2 Drum. Bent Tube. Economisers. Internal Desuperheater. Superheaters. W.P. 400 P.S.I. Hydrostatic Press. 718 P.S.I. Heating Surfaces: 2441 sq. ft. Superheater 350 sq. ft. Economiser 1620 sq. ft. 3 Todd "Hex Press" Fuel Oil Burners. Diamond Soot Blowers. Auxiliaries available.

NUMEROUS OTHER ITEMS ARE AVAILABLE

MILNOR & BLEIGH STS. • PHILA. 35, PA.

Phone MAyfair 4-1400

STEEL STORAGE TANKS

2—1000 & 2—10,000 Bbl. New Vertical
6—74,000, 55,000 & 37,500 Bbl. Vert.
8—25,000 Gal. Cap. Horizontal
50—10,000 & 3—20,000 Gal. Horizontal
6—10,000 & 12,000 & 16,000 Gal. ⅜" Shell
20—10,000 Gal. Cap. 60 lbs. Press. Test

L. M. STANHOPE, Rosemont, Penna.

asme — BOILERS — Nat'l B'd.

2—404 H.P. Springfield sectional header
5—300 H.P. Combustion Engineering Co.
4—250 H.P. Stirling, Class-H.
2—600 H.P. Stirling type, Spreader stokers
3—72" } suspended H.R.T. single set
2—84" }

H. P. BREARLEY
34-23 91st STREET JACKSON HEIGHTS, N. Y.

ELECTRICAL CABLE

- for every industrial and power application
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
- Cut to length. Reasonably priced.

UNIVERSAL WIRE AND CABLE CO.
2668 N. Clybourn Ave., Chicago 14, Ill.

500 KW, MG SET, 250 volts DC, 2300 volts, 3 ph. Syn.
2000 KW—G.E. Turbine Set, 3 phase, 480 volts.
1000 KW—G.E. Turbine Set, 3 phase, 480 volts.

TARPY ELECTRICAL MACHINERY
2439 N. 9th St. Philadelphia 33, Pa.

"You can prove anything by STATISTICS"

BUT HEMPHILL EQUIPMENT PROVES ITS VALUE BY PERFORMANCE!

JLHCo

GUARANTEED BECAUSE REBUILT AND TESTED UNDER SUPERVISION OF HEMPHILL ELECTRICAL ENGINEERS

TRANSFORMERS — 60 Cycle

Qu.	KVA	MAKE	TYPE	Ph.	VOLTAGES
1	1000	GE	Auto	3/2	4150 x 2406
1	1000	GE	Auto	3	2810Y-2300Y
1	500	Kuhl.	OISC	1	4600 x 2300V.
3	400	GE	H	1	6900 x 2250V.
1	300	Pitts.	ODSC	1	7800 x 440V.
3	300	GE	H	1	2400 x 120/240
1	200	Whse.	Auto	3/2	4150 x 2300
1	200	Pitts.	OISC	1	4000 x 110/220
1	200	GE	Auto	3/2	4150 x 2300
1	150	GE	KS	1	2300 x 230
1	100	Pitts.		1	2750 x 110/220
3	100	Wagner	RCKV	1	240 x 120/120
2	100	Whse.	SK	1	4400 x 220/440 Taps
2	100	Newark	Dry	3/2	440 x 220
3	100	GE Pyrn.	H	1	4160 x 220/440
3	100	GE	Auto	1	4150 x 2300
1	100	Amer.	OC	1	15000 x 2300
3	75	GE	H	1	2400 x 230/440
3	75	Whse.	SK	1	2400 x 440
7	50	Whse.	SK	1	13750 x 125/250
11	50	GE	H	1	13750 x 125/216
5	50	Whse. Inert.	S	1	4160 x 120/240
2	37½	GE	H	1	2400 x 120/240
2	37½	AC Dry	AD	1	450 x 120
1	37½	Amer.	RS	1	13800 x 220/440
1	37½	GE	H	1	13800 x 220/460
1	37½	Amer.	OISCID	1	13200 x 230/440
3	27½	GE	Dry	1	440 x 220/110
12	25	Whse.	Dry	1	440 x 230/110
1	25	Maloney	Oil	1	230/460 220/110

A.C. GENERATORS
3 Phase, 60 Cycle

Qu.	KVA	MAKE	TYPE	VOLTS	SPEED
1	2500	Whse.		2300	720
1	625	GE	ATB	600	3600
1	375	AC		480	450
1	300	GE	ATB	600	600
1	200	AC		240	3600
1	200	Whse.		240	600
1	225	Whse.		550	514
1	125	GE	ATB	240	600
1	170	Whse.		2200	900
2	80	Whse.		220/440	900
3	44	Columbia		240	1200
1	31	Amer.		120/208	1200
1	18.75	Star		220/440	1800
1	12.5	Whse.		240	1200

D.C. MOTORS

Qu.	HP	MAKE	TYPE	VOLTS	SPEED
1	125	GE	RC	230	1700
1	100	GE	LC	230	625
1	80	GE	CDM	230	1750
1	75/100	CW	CMC	230	300/1000
1	75	CW	WP	230	860
1	75	GE	C	230	575
1	50	GE	CD	240	650/1300
1	50	CW	CM	230	700
1	40	GE	LC	230	700/1000
1	35	GE	RC	230	860
1	30	GE	CDM	230	1600/1850

D. C. MOTORS (Cont.)

Qu.	HP	MAKE	TYPE	VOLTS	SPEED
1	30	GE	RC	230	1150
1	30	GE	RC	230	1100
1	30	GE	C	230	625
1	30	GE	RLC	230	400/1200
1	25	Whse.	SK	230	825
1	25	Whse.	SK	230	600
1	25	Whse.	SK	230	400/1200
1	25	CW	CMC	230	335/670
1	25	Whse.	SK	230	300/1200

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

Qu.	KW	MAKE	SPEED	DC	AC
1	1000	Whse.	720	275	2300/4150 Syn.
1	1000	GE	514	600	2300/4150 Syn.
1	500	GE	900	275	2300/4150 Syn.
1	400	GE	900	275	2300/4150 Syn.
1	300	GE	1200	250	2300 Syn.
2	150	GE	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	2300 SC
1	100	CW	1200	125	220/440 SC
1	100	El.Mach.	1200	125	4150 Syn.
2	75	GE	1200	125	220/440 SC
6	75	GE	1200	60	220/440 SC
1	50	Ridgeway	1200	550	220/440 SC
1	50	Whse.	900	250	220/440 SC
2	40	El.Mach.	1750	125	440 SC
1	35	Ideal	1200	125	220/440 SC

OIL CIRCUIT BREAKERS

1—3000	A GE	15000V	3 pole	FK	130
1—3000	A GE	4800V	3 pole	FK	12
2—3000	A GE	600V	3 pole	K	25
1— 600	A Condit	15000V		DR	100
1— 400	A Whse.	37000V		O	221

FLEX ARC WELDER
2—500 Amp. Whse. AC Welder

SPECIAL
1—120 KW 150 KVA Ames Uniflow 16 x 16 220V, 3 ph, Non-Condensing.

NEW CONTROL
4—150 HP GE CR 7041 Sq. Cage Automatic 440V, 3 ph.

Welding Motor Generator Set
1—176 KVA 2202 .57 PF single phase with exciter and 75 HP motor and controls.

A.C. MOTORS
3 Phase, 60 Cycle
Synchronous

Qu.	HP	MAKE	TYPE	VOLTS	SPEED
4	200/100	Whse.		4150	720/360
1	200	El.Mach.		2300	360
1	200	GE	TS	440	257
1	185	GE	ATI	2300	720
1	150	GE	TS	220	1800
3	150	AC		2200	360
1	100	GE	ATI	2200	900
1	70	El.Mach.		2200	180
1	35	GE	ATI	2200	1200
1	20	Whse.		220	1800

SLIP RING

1	2500	GE	MT	6600	257
1	500	GE	MT	2200	720
1	300	Whse.	CW	440	600
1	250	Whse.	CW	440	600
1	200	Whse.	CW	440	600
1	150	GE	IM	440	450
1	100	GE	IM	440	400
1	75	GE	MT	220	1200 Vert
1	75	GE	MT	440	900
1	60	GE	MT	220	1730
1	60	GE	MT	440	900
1	50	GE	MT	220	1720
1	50	GE	MT	220	1200
1	50	Whse.	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	800
1	40	GE	MT	220	1200
1	40	GE	MT	2200	1200

SQUIRREL CAGE

Qu.	HP	MAKE	TYPE	VOLTS	SPEED
1	150	CW		2200	1200
1	125	GE	KF	2300	1800
1	125	US		440	1200 Vert
1	100	LA	RY	440	1800
1	100	Whse.	CS	440	1800
1	75	GE	KF	220/440	1200
1	75	Ideal	AT	220/440	1200
1	60	Whse.	CS	2200	900 Vert
1	40	GE	KT	220	1200
1	40	Whse.	CS	220	900
1	40/20	Whse.	CS	440	575/435
1	35	Whse.	CS	2200	1200
1	35	GE	IK	550	600
1	30	GE	KT	220	600
1	25	GE	KT	220	1165
1	25	GE	KT	440	1200

LARGE STOCK OF D.C. MOTORS AND GENERATORS, SWITCHBOARD AND CONTROL EQUIPMENT

JLHCo

This Seal is Your Guarantee

J. L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK — LONGACRE 5-3227

PHONE NEW JERSEY — UNION 3-2600

MOTORS - M.G. SETS - CONTROLS

AT REDUCED PRICES!

NEW SLIP RING
2—New 500 HP, 1200 RPM Elliott, 220/440 V., 3 Ph., 60 Cy., Shaft 4½" dia. x 8" long. (Photo right.) Control Available.

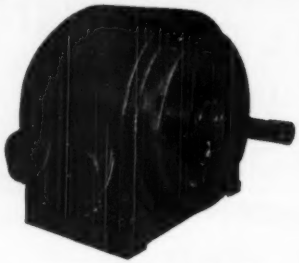
M-G SETS

D.C. KW	D.C. Volts	A.C. Volts	Mfg.
500	250	2200	C-W
400	125/250	2300	Ideal
300	250	2200	G.E.
300	125/250	440/2300	Allis (New)
200	250	2200	Whse.
200	125/250	2200	G.E.
150	250	440	G.E.
125	250	440	Whse.
100	250	220/440	Star (New)
75	250	440	C-W
60	250	220	G.E.
50	250	440	Whse.
20	250	440	Star

Reconditioned and guaranteed

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
800	150	440	G.E.	80%
650	138	2300	Whse.	Engine
500	514	440	E-M	100%
400	900	2300	Whse.	80%
400	720	440	G.E.	80%
400	600	440	G.E.	100%
400	514	440	G.E.	100%
350	900	440	G.E.	100%
350	200	2300	Whse.	100%
300	514	440	G.E.	100%
250	600	4160	E-M	100%
150	900	2300	G.E.	100%
75	900	220	E-M	80%



SLIP RING — R & G.

HP	RPM	Volts	Mfg.
1000	514	4000	Whse.
800	514	2300	Whse.
700	450	2300	G.E.
700	720	2300	Allis
500	450	2300	G.E.
450	514	440	Whse.
400	720	2300	G.E.
350	450	2300	Whse.
300	600	440	G.E.
250	600	440	G.E.
200	1200	440	G.E.
150	1200	2300	G.E.
150	900	2300	C-W
150	600	440	G.E.
125	900	440	F-M
125	720	220/440	E-M
100	900	2200	A-C
50	720	220	Whse.

NEW DIRECT CURRENT

230 Volt Drip proof — ball bearing

Qu.	HP	RPM	Mfg.	Frame
3	3	690/2660	G.E.	284
12	5	850/1700	G.E.	CD-66
5	7½	575/1750	G.E.	CD-77
2	7½	575/2300	Rel.	T-46
1	10	575/2300	L.A.	4051
3	10	1750	Rel.	T-34
2	30	850/1700	Rel.	T-230
1	75	400/1200	Rel.	T-651
5	250	1750	A-C	149

Reconditioned and guaranteed
230 VOLTS D.C.

HP	RPM	Mfg.	Brg.
250	400/1200	E-D	Ball.
200	300/ 900	Whse.	Ped.
200	400/1200	Rel.	Ball.
150	350/1200	Whse.	Ped.
150/200	300/ 900	Rel.	Ball.
125	400/1200	G.E.	Sleeve
125	300/ 900	Rel.	Sleeve
100	500/1300	C-W	Ball.
100	475/1350	E-D	Sleeve
75	500/1500	C-W	Ball.
60	400/1200	Whse.	Sleeve
50	350/1050	Whse.	Ball.
40	400/1600	Rel.	Ball.

NEW SLIP RING CONTROLS
10—250 HP 440/3/60 Fully Magnetic, Reversing, 7 steps acceleration, Allis-Chalmers, with air ckt. brkr. Open or enclosed.

Buy from BOSWICK with confidence

WAlbridge 1195

BOSWICK ELECTRIC CO.

P.O. BOX 55 AKRON 9, OHIO

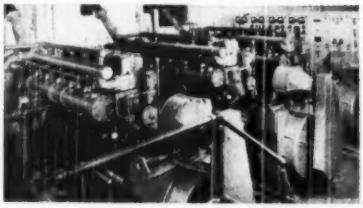
FOR SALE
WORTHINGTON-WESTINGHOUSE
INSTALLATION

COMMERCIALLY UNUSED

•

IMMEDIATE DELIVERY

•



3 Worthington Model BB 5—150 HP Diesel Engine Generating Units direct connected to Westinghouse Generators.

Rated 100 KW—125 KVA—3 phase, 60 cycle, 460 Volts, AC Current at 600 RPM.

Suitable for reconnection to 85 KW—3/50/230/400 at 500 RPM.

Complete with all accessories and auxiliaries including evaporative coolers—switchboard—distribution panel.

OWNED & OFFERED BY

KANE-McGUIRE COMPANY

Single units available

1492 East 32nd Street
Brooklyn, New York
PHONE: WHitehall 3-6843

GENERATOR SETS

100 KW 200 KW

General Motors Diesel engines, 8 cyl., Model 8-268A, 6¼" bore x 7" stroke. Direct conn. to: 200 KW WESTINGHOUSE ALTERNATORS, 3 phase, 60 cy., 440 V., including switchboards.

ALSO—COMPLETELY REBUILT

3 cylinder General Motors Diesel Engine Sets Direct Conn. to: 100 KW CENTURY ALTERNATORS, 3 phase, 60 cy., 440 Volt, Inc. switchboards.

OTHER SIZES IN STOCK FROM 10 to 1000 KW. Ready for immediate shipment.

ALJOHN DIESEL CO., Inc.

904 Pacific St. Brooklyn 16, N. Y.

Sterling 3-6515

two 100 KW 250 Volt DC Generators. Steam driven by Ball Engines—140# pressure.

one 200 KW 250 Volt DC Generator. Steam driven by Ball Engine—140# pressure. Units complete with DC switchboard and two balancer sets.

one 20 ton York Vertical Ammonia Compressor. Steam driven by Corliss Engine—140# pressure.

one 15 ton York Vertical Ammonia Compressor. V belt drive. 33 H.P.— DC motor. Complete with condenser, receiver, valves, gauges, etc.

PURITY BAKERIES

97 E. 12th Street St. Paul 1, Minn.

POWER EQUIPMENT—READY TO SHIP

A.C. MOTORS—3 PH. 60 CY.

No.	HP.	Make	Type	Speed	Volts
1 NEW	200	West.	STN	1200	220/440
1	250	Burke	STN	720	2200
1 vert	250	G.E.		1175	2200
1	200	G.E.	I	850	2300
1	200	G.E.	SYN	1800	2200/550
1	175	West.	MS	1200	220/440
1	150	West.	STN	257	220/440
1	150	West.	STN	600	220/440
1	150	West.	STN	900	2300
1	150	G.E.	I-K	1200	2300/220/440
1	150	West.	MS	1200	220/440
3	150	Louis Allis	FX	1750	220/440
4 NEW	125	West.	STN	1200	220/440
1	125	G.E.	I-K	900	220/440
1 NEW	125	Elec. Mach.		580	2300/440
1	125	Elec. Mach.	STN.	164	220/440
1	112	West.	STN	1200	220/440
1	100	Reliance	IT	495	220/440
1	100	Al. Chal.		720	220/440
1	100	G.E.	I-K	900	220/440
1	100	G.E.	I-K	900	2200
1	100	West.	STN	900	220/440
1	100	Cr. Wh.	SC	1100	2200/220/440
1	75	Elec. Mach.	STN.	900	220/440
1	75	Master	PA	1750	220/440
1 NEW	75	Al. Chal.	AB	865	220/440
1	75	Al. Chal.		580	220/440
1	75	West.	CS-877C	600	220/440
1	75	G.E.	I-K	600	220/440
1	75	G.E.	I-K	720	2200
1	75	G.E.	I	720	220/440
1	75	Louis Allis	OGS	1200	220/440
1	75	Burke		1200	220/440
1	75	Louis Allis	FAA-503Y	1150	220/440
2	75	West.	CS (TEFC)	1750	220/440
1	60	G.E.	KT-533	1800	550
1	60	Burke	—	900	220/440
1 NEW	60	Reliance	TEFC	880	2200/550
1	60	Al. Chal.		515	220/440
1	60	G.E.	I-K	600	220/440
1	60	Cr. Wh.	SC	720	220/440
5 NEW	60	West.	CS-607	900	220/440
		(EXPLOSION PROOF—TEFC)			
1	60	Elec. Dyn.	drip pr.	3600	4000/2300
1 NEW	50	West.	TEFC	1765	220/440
1	50	Wagner	TEFC	1750	220/440
1	50	West.	CS	1750	220/440
1	50	G.E.	KF	960	220/440
1 NEW	50	Reliance	C	720	220/440
2	50	G.E.	KT-546	730	220/440
2 NEW	50	Reliance (TEFC)	B-504-S	1750	2200
3 NEW	50	G.E. (TEFC)	K-504	1750	2200
1 NEW	30	West.	CS-443 ld-torq	900	220/440

VARIABLE SPEED MOTORS—230 V. D.C.

HP	Make	Type	Rpm
100	West.	SK-190	500/1000
75	Louis Allis	F-210	400/1200
60	Louis Allis	F-210	400/1200
50	West.	SK-179	250/1050
50	West.	SK-153	600/1200
40	Elec. Gen.	180-S	385-1200
30	West.	SK-130	975/1750
30	G. E.	DLC-50	400/1200
30	West.	SK-130	725/1450

SLIP RING MOTORS—3 ph. 60 cy.

HP	Make	Rpm	Volts
600	Ideal	1770	220/440
500	Ideal	1770	220/440
400	Ideal	1770	220/440
250	Crocker Wh.	600	220/440
75	G.E.	450	220/440
60	G.E.	570	220/440

A. C. GENERATORS—3 ph. 60 cy.

No.	Kva	Make	Rpm	Volts
6 NEW	100	West.	1200	220/440
10 NEW	37½	West.	900	220/440
3	25	Onan	1800	220/440
11 NEW	25	West.	900	220/440
		(1 ph.)		

M.G. SETS—"SPECIALS" READY TO SHIP

250 kw. West. 125/250 v. D.C. 2300/4000 v. 3 ph. 60 cy. 1200 rpm. Syn.

SPECIAL BARGAINS

Diesel Engine Generator Sets

10—100 kw., 120/240 v. D.C. Delco Generators dir. conn. to 188 HP Model GBD-8, 8½x7, 8 cyl. Superior DIESEL Engines, elec. start with engine panels

4—100 KW same as above with 220 or 440 v. NEW A.C. Generators

1—62 kva, 120/208 v. 3 ph. 60 cy. 1800 rpm., driven by Cat. DIESEL mt'd on trailer

1—66 kva Fairbanks Morse 220/440 v. 3 ph. 60 cy. 300 rpm DIESEL

1—75 KW 220/440 v. 3 ph. 60 cy. International GASOLINE

2—75 kva. 220/440 v. 3 ph. 60 cy. Delco Cummins DIESEL

1—62 kva Fairbanks Morse 220/440 v. 3 ph. 60 cy. 1200 rpm DIESEL

2—37½ kva., 220/440 v. 3 ph. 60 cy. Buda DIESEL

10—NEW 37½ kva., 220/440 v. 3 ph. 60 cy. LeRoi Gasoline

1—31.3 kva. 120/208 v. 3 ph. 60 cy. G.E. Gen. driven by LeRoi GASOLINE

11—NEW 25 kva. 120/220 v. 1 ph. 60 cy. Le Roi GASOLINE

3—25 KW BRAND NEW Onan 220/440 v. 3 ph. 60 cy. 1800 rpm GASOLINE

1—12½ kva. 120/240 v. 1 ph. 60 cy. 1200 rpm., dir. con. Hercules GASOLINE

3—12 kva 120/240 v. 1 ph. 60 cy. Le Roi GASOLINE

2—1½ kw. 120/208 3 ph. 60 cy. Buda GAS.

250 kw. West. 250 v. D.C. 1200 rpm., 380 HP. Syn. Motor 2300/4000 v. complete with switchboards.

200 kw. West. 125/250 v. D.C. 3 wire 220/440 v. A.C. Syn.

200 kw. West. 250 V. D.C. 1200 rpm., dir. conn. 280 HP. 220/440 v., 3 ph. 60 cy. Syn. Motor. A.C.

MOTOR GENERATOR SETS—250 V.D.C.

Motors 220/440 volt or 2200 volt 3 phase, 60 cycle

No.	KW	Make	Rpm
2	250	Westinghouse	1200
1	200	Westinghouse	720
2	200	Westinghouse	1200
1	100	Westinghouse	700
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	580
1	100	Delco	1200
4	75	Westinghouse	720
1	75	Westinghouse	1200
1	60	Westinghouse	1200
3	40	Westinghouse	900
2	30	Westinghouse	720

125 V. DO M.G. Sets

1—100 kw. G.E. 125 v. 800 rpm. 220/440 v. 3 ph. 60 cy. AC Syn.

1—75 kw. West. 125 v. 1200 rppm. 220/440 v. 3 ph. 60 cy. Syn.

TRANSFORMERS—1 ph. 60 cy.

No.	Kva	Make	Pri.	Sec.
1	500	Standard	2300	575/460/345 230/115
2	500	G.E.	2300	230/460
6	333	Maloney	2300	230/460
3	200	G.E.	2300/4600	230/460
5	150	West.	2400/4160	240/480
5	150	Pgh.	2300	230/460
1	100	Peerless	2300	230/460

NEW DIESEL ENGINES

3—HERCULES, 6 cyl. with power takeoff, max. 135 hp. @ 3600 rpm min. 60 HP @ 1200 rpm.

NEW AXIAL FLOW VENTILATING FANS

20—6000 cfm Sturtevant Bulletin 512240 3" stat. pres. 7 blade dir. con 5/1.5 HP 1765/1175 rpm 220/440 v. 3 ph. 60 cy. Westg. TEFC Motors

5—5000 cfm 3.2" stat. pres. Sturtevant with 2 speed 220/440 v. 3 ph. 60 cy. Motors

2—10,000 cfm LADEX dir. con. 2 speed 220/440 v. 3 ph. 60 cy. Motors

1—12000 cfm 3" stat. pres. with 2 speed 220/440 v. 3 phase 60 cy. Motors

2—10000 cfm 3" stat. pres. Buffalo Forge with 2 speed 220/440 v. 3 ph. 60 cy. Motors

1—67000 to 38000 cfm 1" to 9.3" stat. pres. Size 50" dia. 72½" I. 2 sets propellers International Eng. Co. driven by 100 HP AC Motor

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

MERCURY ARC RECTIFIER

1—300 KW WEST. 250 V. DC, 2300 V. AC

MOTOR GENERATORS

1—500 KW G.E. Syn. 250 V. 900 RPM
1—400 KW WEST. Syn. 600 V. 720 RPM
2—300 KW G.E. Syn. 250 V. 1200 RPM
1—300 KW G.E. Syn. 600 V. 1200 RPM
1—200 KW G.E. Syn. 250 V. 1200 RPM
1—200 KW G.E. Syn. 600 V. 1200 RPM
1—150 KW G.E. Syn. 250 V. 1200 RPM
1—100 KW G.E. Ind. 250 V. 1200 RPM

ROTARY CONVERTERS

1—300 KW G.E. Syn. 600 V. HCC 1200 RPM
1—100 KW G.E. Syn. 250 V. TCC 1200 RPM

ARMATURES

1—500 KW G.E. 250 V. MPC 900 RPM Arm.
1—300 KW G.E. 250 V. HCC 1200 RPM Arm.

AIR COMPRESSORS

2—4200' I-R type PRE-2, Size 35x20½x24 Direct Connected to 700 H.P. G.E. Syn. TS Motor 440/2300/4000 V.

WALLACE E. KIRK COMPANY
502 Grant Bldg., Pittsburgh 19, Pa.

DIESEL POWER PLANTS

Immediate Delivery From Our Warehouse

6—100 KW WORTHINGTON DIESEL ENGINES

Model BB-5, 5 cylinders, 600 RPM, direct connected to Westinghouse, 125 KVA, Generators, 3 phase, 60 cycle, 230 or 460 volts.

Completely equipped with Evaporative Cooler, Starting Equipment, Switchboard, Silencers and Fuel Tanks.

These units were never commercially used—run for test purposes only.

Heat and Power Co., Inc.

70 PINE STREET — DIGBY 8-0373 — NEW YORK 5, N. Y.

MODERN AIR COMPRESSORS

6040 Ft. INGERSOLL RAND 60 LB. ELECTRIC.
3—3865 Ft. NEW CHICAGO PNEU. OCE. ELEC. 125 LB. WITH MOTOR TO SUIT.
3176 Ft. SULLIVAN WR4 ELECTRIC. 125 LB.
1578 Ft. CHGO. PNEU. DIESEL. 125 LB.
1302 Ft. INGERSOLL RAND PRE-2 ELECTRIC. 100 LB.
810 Ft. WORTHINGTON V BELT DRIVE. 125 LB. WITH OR WITHOUT MOTOR.
DARIEN, 60 E. 42nd St., New York 17, N.Y.

SPECIAL TRANSFORMERS — YOUR SPECIFICATIONS

NEW TRANSFORMERS
OIL COOLED
AIR COOLED
PHASE CHANGERS

ARROW TRANSFORMER CO., INC.
1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0433

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

Reliably Rebuilt Electrical Equipment

Rebuilt — 1 YEAR GUARANTEE

PARTIAL LISTINGS ONLY

MOTORS
Squirrel Cage 3 Phase

HP	Make	Type	Speed
450	GE(vert)	KF-6338	1180
200	Wagner	RP2	1750
200	GE	KF-6335	880
150	West(2)	CS	1750
150	West	CS	580
125	AlCh(2)	AR	435
100	Wagner New	XP	1150
100	GE	K-544	1175
100	West	CS	870
100	GE	IK	720
75	West	CS	1750
75	GE(3)	K-505	1175
75	GE	IK	900
75	GE(3)	KT-352	865
75	West	CS	720
75	GE	K-356	690
75	GE	KT-558	580
60	F-M	Tot.Enc.	1800
60	West(2)	CS-607	880
60	Rel(2)	AA	875
60	GE	KT-346	865
50	GE	FTR-523	3600
50	Elliott	196	3450
50	West	CS	1740
50	LA(3)	XP	1150
50	West	XP	1150
50	GE	KF-445	1170
50	West	CS-642C	1160
50	West(3)	CS	870
50	GE(2)	IK	870
50	GE	FTR-542	870
50	West	CS	690

MOTORS
Slip Ring 3 Phase

HP	Make	Type	Speed
600	CrWh	131AQ	507
500	GE	IM	1200
500	GE(2)	IM	450
400	West	CW	514
225	Wagner	25cy	710
200	GE	MTP-557	1800
200	GE(2)	IM	1170
150	Wagner	31VRN	900
150	GE	MT-564Y	580
100	GE	MT-553	1165
100	AlCh		690
75	West	CW	1150
75	GE		690
50	West	HF	850
50	AlCh		690
50	GE	MT-536	1150
50	West	CW	1150
50	GE	MT-336	1150
50	LA	OGH	870
50	F-M	BV	600
50	AlCh	ARY	575
50	GE	IM	490

MOTORS
Synchronous

HP	Make	Type	Speed
600	AlCh(2)		120
475	West		720
400	GE(2)	TS-928S	600
300	GE	ATI	900
260	GE	TS	900
250	Ideal		360
200	GE(2)	25cy	500
200	Ideal	SMW	257
180	GE	ATI	900
160	GE	TS	1200
145	GE	ATI	720
135	West	G	1200
135	Ideal		1200
100	GE	TS	1200
100	ElMach		200
55	ElMach	BRKT	1200

MOTORS — 230V. D.C.

HP	Make	Speed
400	AC	415
135	CW	233/900
125	GE	1750
100	GE	1750
100	AlCh	1150
90/45	GE	950/475
75	Sprague	1000/1500
75	West(2)	475
75	CrWh	480/670
75	CrWh	375/950
75	West(3)	250/1000
60	West(3)	680
50	GE	1750
50	Diehl	850/1050
45/90	GE	475/1950
50	West(3)	565
50	GE	250/1000
50	West	250/1000
40	West	1750
40	Century	1740
40	GE	1700
40	GE	1100
40	GE	750
40	GE(2)	400/1500
40	CrWh	700
40	Rel	400/1200
35	West	1150
35	GE	440/800
30	GE(8)	2200
30	West	975
30	Cont	850
30	GE	775
30	West	500/1500
30	West(2)	575
25	GE	1750
25	West	1750
25	GE	1750
25	ED	1500
25	Rel	1150
25	West	500/1500
25	West(2)	600
25	GE	300/1200

MOTORS—550V. D.C.

HP	Make	Speed
765	GE(6)	1045/1350

GENERATORS
250V. D.C. M.D.

KW	Make	Speed
1000	GE	900
500	West	1100
300	Elliott	1200
300	GE	1200
300	AlCh	1200
200	GE	1200
150	West	900
100	Delco	1200
75	GE	1200
50	GE	1200
40	Rel(4)	1750
42	ABC(2)	1200
30	GE	1200
25	GE	1200

GENERATORS
125V. D.C. M.D.

KW	Make	Speed
250	GE	720
150	CrWh	1200
150	West	1150
100	West(2)	900
100	GE	1200
75	ElMach	1200
75	CrWh	1200
75	Hertner	1150
50	West	1150
50	CrWh	1150
50	Sturt	2800
35	Ideal	1200
30	GE	1150
30	LA	1450
25	ElMach(2)	1150

A.C. GENERATORS
Driven by D.C. Motors

KVA	Make	DC Input	AC Output
288	West	115	450
75	GE	230	240
50	Star	115	120
35	GE	230	220
31	Ideal	115	440
31	ElMach	230	440
18	GE	230	120/240
10	Burke	115	120
7½	Hertner	115	440
5	ElSpec	115	110
1¼	AlCh	230	110

GENERATORS—A.C.

KW	Make	Type	Speed
216	West	G	900
180	GE	ATB	900
100	GE	ATB	360
75	GE(2)	ATB	1200
50	F-M	GG	1200
15	GE	ASI	1200

TRANSFORMERS

4—333 KVA Moloney, 2300/4600 V. primary, 230/460V. secondary.
1—300 KVA, Al. Ch. 3 ph, 41600 V. primary, 230V. secondary.
1—300 KVA, Pittsburgh, 3 ph, 41600 V. primary, 230V. second.
8—100 KVA West. 3 ph. 440-220 Dry.
2—50 KVA GE—H—KF, 2400/4160Y—120/240V. secondary.
4—25 KVA West 440V. primary, 110/220V. secondary
3—15 KVA West 440V. primary, 110/220V. secondary.
60—Additional Oil and Insulated Dry-type Transformers in stock not listed, down to 1 KVA.

L. J. LAND, INC.

EST. 1910 — 41st YEAR

156 GRAND ST. CAnal 6-6976 NEW YORK 13, N. Y.

-TRANSFORMERS-

BOUGHT AND SOLD

We carry a large stock of transformers, and invite your inquiries.

PIONEER TRANSFORMER REBUILDERS

We rewind, repair and redesign all makes and sizes.

One Year Guarantee.

THE ELECTRIC SERVICE CO., INC.

"AMERICA'S USED TRANSFORMER CLEARING HOUSE"

SINCE 1912 CINCINNATI 27, OHIO

FOR SALE

3—151 H.P. Murray Long Level Drum Boilers. Complete with valves, fittings and accessories.

3—Westinghouse Single Retort Underfeed Stokers. Complete with all accessories.

Above equipment now in operation and in excellent condition. Purchased new 1935. All units carry State and Insurance Operating Permits. Best bids in writing will be considered at 1:30 P.M., Friday, July 21st.

Account of electrification of Pumping Plant, above equipment to be removed by August 15th. Personal inspection solicited. Write or Phone 7705.

WATERLOO WATER WORKS
WATERLOO, IOWA

NEW OIL FIRING EQUIPMENT

Tanks, heaters, pumps, burners, controls and instruments—still in original crates. If interested in oil firing, mail card to Chief Engineer for complete description.

August Wagner Breweries Inc.
Columbus, Ohio

1—60, 100, 125, 150 HP Erie Economic Boilers
2—593' G-D Motor Driven Air Compressers
1—10 Ton 75' & 15 Ton 45' Overhead Cranes
1—18,000 Gal. Welded Steel Oil Tank
1—60'x200'x16' Steel Building
1—100 & 125 HP Steam Generators
2—25 HP 100# Vertical Boilers
2—500 HP B&W Sterling Boilers

H. & P., 6719 ETZEL, ST. LOUIS 14, MO.

CONDENSERS—SURFACE
NEW & UNUSED

2—GRAHAM, 100 sq. ft.
6—CROLL-REYNOLDS, 300 sq. ft.
6—DOWNINGTON, 580 sq. ft.
1—GRAHAM, 1500 sq. ft.

SUNDFELT EQUIPMENT CO., INC.
220 Hudson St. Seattle 8, Wash.

FOR SALE
GEARHEAD MOTORS

100—Westinghouse 2 HP, 157 RPM, 3/60/220-440, other sizes up to 15 HP.
Speed Reducers from 3:1 to 1980:1 and up to 30 HP.

SURPLUS & SALVAGE CO., INC.
620 W. 8th St., Jamestown, N. Y.

---

2 WESTINGHOUSE
SINGLE RETORT STOKERS

Serial #9557858, Size 94-Kx7' 1½" complete with grates, Boiler Front and Hydraulic-Drive. $500 each. F.O.B. ROCKY MOUNT, N. C.

FS-6930, POWER
330 W. 42 St., New York 18, N. Y.

FOR SALE

300 KW 220 DC Elliot Turbine Generator in A-1 condition.

WILLIAM L. MARTIN, II, Trustee
Box 476, Bridgeton, New Jersey

TRANSFORMERS — FOR SALE

1 Phase 60 Cycle

Rebuilt and Guaranteed

3—1250 KVA—G.E. 13800 2400
3—1000 KVA—G.E. 13800 480
3—1250 KVA—G.E. 6900 480
3—1000 KVA—G.E. 4800 480
6— 500 KVA—West. 2400 240/480
9— 333 KVA—West. 6900 480
9— 333 KVA—West. 4800 480
9— 333 KVA—West. 2400 480
3— 200 KVA—G.E. 2400 480/240
3— 150 KVA—G.E. 2400 480/240
3— 100 KVA—G.E. 2400 480/240
3— 100 KVA — G.E. 6900/11950Y 460/230
3— 75 KVA—West. 4800/2400 460/230
3— 50 KVA—G.E. 4800/2400 460/230/115
3— 37½ KVA — G.E. 4800/2400 460/230/115

We Also Solicit Your Inquiries for Special Transformers Including Furnace Transformers

BUFFALO TRANSFORMER CO.
1510 NIAGARA ST.
BUFFALO 13, N. Y.

BOILERS

10 to 1000 H.P.

NEW-USED RECONDITIONED

Steam, Gas and Electric Power Equipment

J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547 8-9

MOTORS FOR SALE

AT THE
ARKWRIGHT COTTON MILLS
FALL RIVER, MASS.

Approximately 300 Motors
10 HP to 75 HP
500 V, 900 to 1800 RPM

Contact

Republic Textile Equipment Co.
40 Worth St. New York City
Telephone: COrlandt 7-1591

CONSULT
with us on
Boilers, Turbines, Engines
Diesels, Generators, M.G. Sets,
Transformers & Switchgear

POWER EQUIPMENT

MERRILL and COMPANY
407 So. Dearborn St. • Chicago 5, Illinois

SELLING FOR CUSTOMERS

1500 KW 4000 V Allis Chalmers Cond turbine 200 lb. 5 lb. B.P.
300 KW 240 V Westinghouse geared Noncond turbine
400 KW 480 V 1200 RPM Elliott generator with 1200/4500 gear
285 KVA 240 V Chuse Inflow engine set.
2000 Amp. 3-pole GE Air breaker with Bus Duct.
300 & 200 KW byn M.G. Set with control.

H. BLANE JOHNSON & ASSOCIATES
53 W. JACKSON BLVD., CHICAGO 4, ILL.

THE HOME OF VALUE AND QUALITY FOR . . .

ELECTRICAL POWER EQUIPMENT

WE CARRY A COMPLETE STOCK OF . . .

QUALITY GUARANTEED "REBUILTS"

Our facilities for rebuilding and repair work are the finest in the nation and are supplemented by a staff of thoroughly experienced engineers.

HERE'S A PARTIAL LIST OF OUR HALF MILLION DOLLAR STOCK

SLIP-RING MOTORS
3 phase, 60 cycle—220 or 440 volt (*2200 volt or higher)

H.P.	Make	Type	Speed
2500	*G.E.	MT	257
2000	*G.E.	MT-30	240
1250	*G.E.	M	720
1200	*G.E.	MT-26	277
800	*Westg.	CW	507
650	Westg.	HP	360
500	Westg.	CW	450
500	Westg.	CW	360
400	G.E.	IE	1800
300	*G.E.	IE-15A-4	1800
300	G.E.	IM-17	1200
250	Westg.	CW-32B	900
250	Westg.	CW	600
200	G.E.	IM	600
125	G.E.	I-12M	600
100	G.E. NEW	M-6314	720
100	Westg.	CW-850C	600
100	G.E.	IM-15A	450
75	G.E.	IM-E-14	1800
75	Cr. Wh.	250	600
75	G.E.	IM-14	514
60	*Westg.	CW-750C	900

SQUIRREL CAGE MOTORS
3 phase, 60 cycle—220 or 440 volt (*2200 volt or higher)

H.P.	Make	Type	Speed
750	G.E.	KT	720
500	G.E.	KTP-567	1200
400	*Al. Ch.	ANW	900
300	G.E.	PT-550A	1800
250	Westg.	CW-536A	600
200	Reliance	AA-C6085S	1200
200	*G.E.	IE-15-K	1200
150	Westg.	678-771	1800
150	G.E.	IE-13B	1200
150	G.E.	I-15-S	900
150	Westg.	CS-950A	600
125	G.E. 7EFC	K-6326S	1200
100	*G.E.	PT-5427	1800
100	U.S. Vert.	CPU-994-A	1200
100	Burke	KM-12-S	1200
100	G.E.	K-6353	720
75	Westg.	CS-761	1800
75	G.E.	K-5063	1200
75	*G.E. Vert.	CS	900

SYN. A.C. MOTORS
3 phase, 60 cycle—220 or 440 volt (*2300 volt or higher)

H.P.	Make	Type	P.F.	Spd.
1000	*Westg.	SCD258	.8	900
700	*G.E.	ATI	.8	720
450	El. Ma.		1.0	240
320	*Al. Ch.	Dr. Prf.	1.0	720
250	*Al. Ch.		1.0	720
200	*Al. Ch.		1.0	360
125	G.E.	TS-954S	1.0	1200
100	Cr. Wh.	160-S	.8	900
100	G.E.	ATI	.8	900

A.C. GENERATORS
3 phase, 60 cycle—220 or 440 volt (*2300 volt or higher)

KVA	Make	Type	P.F.	Spd.
1000	*Westg.	803D	.8	900
725	*G.E.	ATI	.8	720
250	*Al. Ch.		.8	720
225	El. Ma.	EM	.8	514
112	G.E.	TS954S	.8	1200
110	*Cr. Wh.	160-S-8	.8	900
100	*G.E.	ATI-8	.8	900

BOILERS
510 HP B&W ASME 160#
500 HP Wicket water tube 175#
100 HP Erie City Box header 200#
200 HP Casey-Hedges 2"x2" tubes

150 HP Burnham ASME compact

MOTOR GENERATOR SETS

K.W.	Make	A.C.	D.C.
1000	G.E.	4600	275
500	G.E.	440	250
500	G.E.	4000	1200
450	G.E.	2300	275
200	Cr. Wh.	2300	120
200	G.E.	440	250
150	Al. Ch.	220	125
100	G.E.	440	250
100	G.E.	235	250
75	Westg.	2300	110
75	Star	440	250
75	Star	440	250
75	G.E.	440	250
60	Al. Ch.	2300	115
40	Cr. Wh.	220	125
30	Cr. Wh.	220	125
25	G.E.	440	250
20	G.E.	440	250
20	G.E.	440	125
15	West. Elect.	230	220

LOW VOLTAGE—M.G. SETS

AMP.	Make	A.C.	D.C.
1500	Chandyn	440	60
1000	Chandyn	440	40
1000	G.E.	220	55
284	Westg.	220-440	55

TURBINE SETS—A.C.

KVA	Make	Press.	Volt
1800	Gen. Elec.	400-C	2300
1250	Gen. Elec.	750-NC	2300
1250	Gen. Elec.	Bleeder	125
625	Al. Ch.	140-G	480
312	Moore C.W.	425-G	480
25	DeLaval C.W.	150-NC	240

D.C. MOTORS—230 V.

H.P.	Make	Type	Speed
250	G.E.	MPC-6A	730
150	G.E.	RC-39A	600
100	Al. Ch.	E-182	575
100	West. Elec.	RC-34	2500
75	G.E.	RC	1200
60	Westg.	SK-135	1200
40	G.E.	RC-34A	750
40	Al. Ch.	R-131	850
35	Cr. Wh.	CM-351	700
35	Sprague	C	600
30	Westg.	SK-120	975
30	Sprague	C-60	300
30	Cr. Wh.	CCM-50H	450
25	Westg.	SK-100L	1200
25	Al. Ch.		700
25	Westg.	S-9	560
20	Westg.	SK-85	1800
20	G.E.	RCU-A29	1150

D.C. VARI-SPEED—230 V.

H.P.	Make	Type	Speed
500	G.E.	MPC	160/ 250
225	Westg.	1M	450/ 900
250	G.E.	MPC	720/ 900
125	Reliance	1050T	600/1800
100	Al. Ch.	E-182	525/1150
60	Westg.	SK-160	880/ 830
35	Sprague	C-60	300/ 900
30	Westg.	SA-8	500/1500
30	Westg.	SA-12	400/1200
25	G.E.	CD-105	500/1500
20	Al. Ch.	E-145	500/1200
15	G.E.	CD-150	400/1600
15	G.E.	RC-116	500/1500
10	G.E.	CD-83	600/1800

HOISTS

Cap.	Make	Lift	Design
1000	Am. Eng.	24	Locomotive
5000	Electric	10	Mine

2 COMPLETE VARI-VOLT DRIVES

M.G. Set, 300 K.W., D.C. gen., Elec. type MPC, 250 volts, 800 amps. 1200 RPM, dir. conn. to 300 HP syn. motor, Gen. Elec. type TS, 3 ph. 60 cy. 440 volt, .8 PF, 1200 RPM. D.C. Motor, 250 HP, Gen. Elec., type MPC, 240 volts, 730/975 RPM, with complete starting and control panels.

1000 K.W. Gen. Elec., type MPC, shunt 275 volt, 3640 amp. direct connected to 1120 KVA Gen. Elec. type TS, 3 ph. 60 cy. 4600 volt, 141 amp. .8 PF, 514 RPM on fab. sub-base 250 volt fields bus excited.

750 K.V.A. DRY TRANSFORMERS

6—750 KVA Westinghouse air cooled Class B, wdg. 16,800 V. pri. to 480 V. sec., 3 ph. 60 cy. 4—2½% taps.

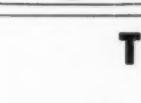
CHICAGO ELECTRIC

Carries a complete stock of "rebuilts" in:

- AC MOTORS
- DC MOTORS
- GENERATORS
- M. G. SETS
- TRANSFORMERS
- SWITCHBOARDS
- COMPRESSORS
- HOISTS
- PUMPS

PHONE
CAnal 6-2900
TODAY

First Source for 40 Years for Quality Electrical Equipment



CHICAGO *Electric Co.*

1320 W. CERMAK RD. • CHICAGO 8, ILL.

TRANSFORMERS

FOR SALE

2— 150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6— 100 KVA. 60 CY. 1 PH. 2400-240/120.
6 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St. Philadelphia 20, Pa.

NO YOU CAN'T BEAT GLOW FOR RELIABLE ELECTRICAL EQUIPMENT

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Westgh
350	3550	2300	Westgh-CS
300	900	440	GE-I-17
250	1200	440	GE-KTR
250	600	2300	Triumph
225	514	440	GE-I-14
200	600	440	Westgh-CS
150	1800	440	Howell-SC
150	600	2300	GK
125	3560	220/440	ALCh.AN
125	1800	220/440	ALCh.AR
125	340	220	ALCh.

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg
400	1200	2300	ALCh.
375	1800	2300	ALCh.
350	900	2300	Westgh
300	720	2300	ALCh.
250	720	440	GE-MT
250	300	2300	ALCh.
200	1800	440	ALCh.
150	1750	440	GE-MT
150	900	2300	ALCh.
100	1200	550	Westgh-CW
100	409	440	W-E-118

MOTOR GENERATOR SETS

KW DC Volts	HP	AC Volts	Make
1800	2750	2500	4000 GE
750	1140	1100	2300 GK
400	250	600	220/440 GE
300	350	443	440 GE-EM
200	250	300	440 GE
150	250	225	440 C-W-EM
100	275	150	440 Wtg.
75	125	115	440 GE
50	125	109	2200 ALCh.
32	125	50	440 GE
25	230	40	220 Reliance-GE
20	250	30	220 GE

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
3000	720	4800	Wtg.
1015	600	2200	Wtg-25 cycle
500	514	440	GE
435	720	2300	GE type ATI
320	900	2300	GE-ATI
250	1800	2300/4160	GE-ATI
250	225	2200	GE-TS
225	900	4160	GE-ATI
220	600	2300	GE-ATI
175	225	220	GE-TS (rotor & stator only
168	600	440	GE-ATI
160	164	480	GE-TSF (rotor & stator only
150	1800	2200	GE
150	1800	220	GE-ATI, single bearing
150	900	440	Star
150	720	440	Westgh

FREQUENCY CHANGERS

KW	Output Volts	Input Volts	Make
2000	2300	2300	GE
1700	250	Any	GE-HCC
1100	250	Any	GE-HCC
100	2300	375	Wtg.
25	220	115	GE
20*	220	220	Delco
15*	220	220	GE
10**	220	550/220	GE

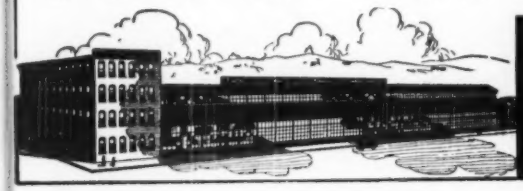
*60/180 cycles—**60/240 cycles

CAPACITORS

KVA	Volts	Phase	Make
75	440	1	Cornell-Dubilier
60	460	3	Westinghouse
15	460	3	General Electric
15	3460	1	General Electric

GLOW ELECTRIC CO., for over 44 years, has done engineered rebuilding of electrical equipment to assure you of quality and dependability.

We invite your inquiries.



GLOW ELECTRIC CO.
927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

Quality SINCE 1906 Wente Motors

WIDE SELECTION UNUSUAL VALUES

THEIR ELECTRICAL CONSTRUCTION HAS BEEN REBUILT... BY EXPERTS

SQUIRREL CAGE
3 ph.—40 cy.—220 or 440 V.
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	G.E.	I (2200 V.)	900
3	50	Al. Ch.		900
1	60	G.E.	KT	1800
4	60	G.E.	KT (2200 V.)	1200
1	60	Reliance	AA	900
1	60	West.	CS (TEFCBB)	1200
1	75	West.	CS (TEFCBB)	1200
1	60	West.	CS Gearhead	233
1	100	G.E.	KT (2200 V.)	900
4	100	G.E.	K (TEFCBB)	1200
1	110	G.E.	KTP	1800
1	125	G.E.	PT	3600
6	125	Al. Wh.	AR	450
3	150	Al. Ch.		1750
1	250	G.E.	KF (Vert.)	3600

SLIP RING—SYNCHRONOUS
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

1	50	Al. Ch.		720
1	50	Ideal	AV	600
1	50	G.E.	I	700
1	60	Ideal	AVX	1200
1	70 KW	G.E.	CW (.7PF)	1200
1	75	West.	CW	400
1	75	G.E.	I	520
1	75	Pr. Morse	BV (2200 V.)	1800
1	100	G.E.	TRB (1.0 PF)	600
1	100	G.E.	I-16 (2200 V.)	450
1	100	KW G.E.	ATB (.8 PF)	900

D.C.—230 VOLT
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	120	KW G.E.	TS (.7PF)	1200
1	125	Pr. Morse	T (2400 V) (PF1.0)	900
1	150	West.	CW	450
1	200	West.	CW (3 Bear.)	600
1	50	West.	SK	850
1	50	G.E.	CD 1341	500/2000
3	50	Reliance	T	2700
1	50	West.	SK (115 V.)	500
1	60	West.	SK (115 V.)	500/1500
1	75	Diehl	K11	700
2	75/100	Reliance	T1650	300/900
1	100	West.	SK	850
1	100	Cr. Wh.	CM	600
1	130	Cr. Wh.	CMC (550 V.)	1200
1	150	West.	SK	400/1200
1	150	West.	SK	850
1	180	Cr. Wh.	CMC	450
2	200	Reliance	T2550	300/900
2	200	G.E.	TLC-74	1350/4000
1	225	West.	SK	1050

M-G SETS

1— 45 KW West. 60 V DC—440 V AC 1200 RPM
4— 60 KW G.E. 60 V DC—440 V AC 1200 RPM
2— 75 KW El. Prod. 220 V DC—440 V AC 1200
1—100 KW West. 250 V DC—440 V AC 1200
1—100 KW West. 250 V DC—440 V AC 900
1—100 KW Reliance 250 V DC—220 V AC 1200
1—100 KW Ridge 275 V DC—440 V AC 1200
1—150 KW G.E. 275 V DC—440 V AC 900

ALSO—4000 motors other than listed from 1 HP to 200 HP

The Wente Electric Co.,
Hamilton 203 NO. FOURTH ST. Ohio
Phone 4-8128

BELT CONVEYOR: 2800 ft. La-Del, 36" all steel, roller bearing equipped, complete with belt and drive; NEW 1947, slightly used.

TRANSFORMERS: 2—2500 KW, 3 phase, 60 cycle, 66,000 to 2300 volts. A complete Sub-Station.

COAL PULVERIZER: NEW, UNUSED, Babcock & Wilcox, capacity 7500 lbs. of coal per hour, 125 H.P. motor, complete.

HAMMER MILL: Jeffrey 24 x 36", type B-3, roller bearings, V-Belt, NEW condition.

A. J. O'NEILL
LANSDOWNE, PA.
Phila. Phones. Madison 3-8300—3-8301

FOR SALE
USED BOILERS

3—10,000' American Red Flash heating
1— 30 HP Scotch Marine, 100# hand fired
4— 90 HP locomotive fire box 200#
4—110 HP locomotive fire box 200#
2—150 HP locomotive fire box 150#
1—250 HP B&W water tube 170#
2—150 HP H R T 150#
1—410 HP Heine water tube 200#
1—505 HP Brise water tube 200#
1000 AC 220 Turbine Generator

NATIONAL BOILER & EQUIPMENT CO.
1501 So. Senate Ave., Indianapolis 25, Ind.

480 HP BUCKEYE
Diesel Engine, 8 Cylinder 10½"x12" stroke, 600 RPM Model 80, late type. Rebuilt.
ALJON ELECTRIC DIESEL CO.
904 Pacific Street Brooklyn 16, N. Y.
STerling 3-6515

DIESEL GENERATOR SET!

225 HP Busch Sulzer Model DF, 3 cyl., 4 cycle, solid injection, 360 RPM. Direct erator with direct connected exciter, air connected 150 KW 3/60/2300 volt genfilter, muffler, etc. A modern unit in perfect condition only $4000 f.o.b. St. Louis.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

LARGE QUANTITY

NEW ILG MARINE BLOWER FANS 24"—6250 C.F.M. 33"—10000 C.F.M. 36"—15000 C.F.M. Axial Flow—Propeller Type. Driven by 230 Volt D.C. Motors.

ELECTRIC APPARATUS REPAIR CO.
1400 N. 6th St. Phila. 22, Pa.

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

CONSULT US FOR

Diesel Gasoline and Steam Generators, Electrical and Industrial Equipment

POWERITE CORPORATION
140 Cedar St. New York 6, N. Y.
Dept. 105 BA 7-8195

DYNAMOMETER FOR SALE

900 HP Midwest Dynamatic Dynamometer, 250 Volts, 1500-3500 RPM, Type 2025-W, Serial No. 2200, Unused w/Toledo Scale, Controls, Etc.

PRICE $2,750.00

PRACTICALLY NEW

WINSTON MACHINERY CO., INC.
517 South Delaware St., Indianapolis 4, Indiana

Holly Gravity Return System
Steam Boilers and Accessories

RUSSELL B. HOBSON and SONS
GREAT NOTCH NEW JERSEY

WANTED

Air Compressors Wanted

Horizontal Water Cooled—Any size also 2 Stage portable unit

L. W. BAUER
North Bergen, N. J.

BUYERS OF SURPLUS COPPER INSULATED WIRES AND CABLES

No lengths too long or too short
TELEPHONE: EASTGATE 7-4778

PIERCE CABLE CO.
2668 CLYBOURN AVE., CHICAGO 14, ILLINOIS

FROM AVAILABLE STOCK

Rebuilt to N.I.S.A. Standards

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1800	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2300/4400
1	1250	G.E.	600	275	2300
1	1000	G.E.	720	250	2300/13200
1	1000	Whse	900	600	2300/4150
1	1000	West.	514	250	4150
1	800	G.E. (SU)	1200	120/240	2300
1	750	Whse	900	250	2300
1	500	G.E.	900	250	440/2300
1	500	G.E.	720	125	2300/4000
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	400	G.E.	720	600	9500
1	350	G.E.	900	125	2300/4150
1	200	Whse.	1200	250	1200
1	150	Cr. Wh.	1200	250	440
1	75	Cr. Wh.	1170	250	220/440
1	75	Cr. Wh.	1200	250	550

ROTARY CONVERTERS

60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	2000	G.E.	514	600	13800
1	2000	G.E.	450	600	2300
1	1000	Whse.	900	600	11000
1	750	Whse.	900	600	13200

RECTIFIERS

1	750	G.E.	BHW	575	2300
1	1000	A.C.	B-613	625	13500
1	1000*	A.B.B.	GRZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	1000	G.E.	Condensing 135/150# ISP 2300/4150 V 3 ph. 60 cy.
2	750	G.E.	Condensing 250/275# ISP 440V. 3 ph. 60 cy. (New 1944)
1	500	Al. Ch.	Non-condensing 125/150# ISP. 5/20# B.P. 480V. 3 ph. 60 cy. with exciter.
2	400	G.E.	Condensing 275# ISP Geared to 1200 RPM. 120/240V. D.C. Generator.
1	300	Worth.	Non-condensing 125/150# ISP 5/20# B.P. 240/480V 3 ph. 60 cy. direct conn. exciter
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM 120/240V D. C.
	200	Cr. Wh.	Condensing 250# ISP GEARED to 1200 RPM—125V. D.C. Gen
1	200	Whse.	Non-condensing 150# ISP 7# B.P. 240V. 3 ph. 60 cy.

TRANSFORMERS

60 Cycles

Qu.	KVA.	Make	Type	Ph.	Voltages
1	2500	Packard	AT	3	13800 x 2300
1	2500	Al. Ch.	OISC	3	13200 x 2300
3	1000	Pitts.	OISC	1	13200 x 2300
2	125	G.E.	H	1	6600 x 500
1	1050	G.E.	WCTH	3	11000 x 445
3	667	Al. Ch.	OISC	1	13200 x 230/460
1	600	Al. Ch.	OISC	3	4000/2300 x 216
3	333	Mahoney		1	7620/13200x120/240
3	333	Pitts.	OISC	1	24400 x 2300
3	250	Al. Ch.	OISC	1	2300 x 230
3	200	Whse.	OISC	1	7200 x 240/480

D. C. MOTORS

	HP	Make	Type	Volts	Speed
2	1750	Whse.		600	535/720
1	1500	Whse.		525	600
1	1200	Whse.		600	425
1	940	Whse.	GM-B.Brg.	250	140/170
1	600/1000	Whse.		450	600/720
1	450	G.E.	MPC	250	115/145
1	400	Al. Ch.	MILL	230	400/800
1	380/480	G.E.	DYNA	230	1335/1500
1	335	Whse.	MG	250	300/900
1	200/300	G.E.	MPC	230	340/930
1	275	Whse.	GM-600-6	230	425/850
1	250	G.E.	MPC	230	400/500
1	150	G.E.	MPC	230	250/450
1	150	G.E.		600	250/750
10	150	Cr. Wh.	83H	230	890

FREQUENCY CHANGERS

1	2000	G.E.	25/60 Cycle 2300/2300V
1	500	A.C.	25/60 cycle 11000/2300V

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3100	G.E.	TB	2300	257
1—3100	G.E.	ATI	4800	514
2—2000	Whse.		2300	120
1—1470	Whse.		4800	900
1—1000	Whse.		2300	180
3— 900	Al. Ch.	(New)	2300	150
1— 650	Whse.	O	2200	138
1— 600	Whse.	Syn.	440	360
1— 500	Whse.	Brg.	2200	128.5
2— 350	G.E.	TB	2300	150
1— 320	G.E.	ATI	2300	600
1— 300	G.E.	ATI	440	720
1— 300	Whse.		2300	720
1— 300	Al. Ch.		440	600
1— 225	G.E.	ATI 1-Brg.	440	900
1— 125	G.E.	ATI	440	450
1— 100	R.M.	Unused	440	600
1— 100	Whse.		550	600

SLIP RING

2— 700	Whse.	CW	2300	900
1— 500	G.E.	IP	550	895
1— 500	G.E.	IM-Mill	2300	450
2— 350	Whse.	CW	2200	900
1— 350	G.E.	MT-443T	2200/4000	353
1— 300	Al. Ch.	3 Brg.	2300	805
1— 300	G.E.	IM	440	720
9— 300	Al. Ch.	ANT	2300	708
1— 250	G.E.	M-507-TEFC	440	600
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2300	1750
4— 125	G.E.	MT-560Y	440/2300	435
4— 100	G.E.	MT-546Y	440/220	435
2— 100	G.E.	IM-16	2300	435
3— 100	G.E.	IM	440	600
3— 100	Al. Ch.	AK	2200	1200

SQUIRREL CAGE

2— 450	Whse.	CS	2300/4150	354
1— 200	G.E.	IK	550	885
1— 200	G.E.	KT-557	440	1800
1— 200/112	G.E.	KP-559BS	440	1170/885
1— 125	Whse.	MS	440	485
1— 125	(New) G.E.	KP-TEFC	440	1190
1— 125	G.E.	KP-TEFC	440	3585
3— 125	Al. Ch.	ARW	2300	1750
1— 100	Al. Ch.	AR	2300	1170
1— 100	G.E.	IK-Vert.	2300	450
1— 100	G.E.	KT-543	220/440	1750
3— 75	G.E.	KT-547Y	2200	1160

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse.		4800	720

RE-NU BILT BELYEA MOTORS

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.
Phone: Journal Square 2-3334
N. Y. Line: REctor 2-7150

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

1—New 18,000 KW 13,800 V. 600# Cd.
2—New 4000 KW 4160 V. 600# Cd.
1—3500 KW 550 V. 200# Cd.
1—2500 KW 550 V. 250# Cd.
2—1500 KW 2300 V. 400# Cd.
2—1000 KW 2300 V. 200# Cd.
2—1000 KW 400 V. 185# Cd.
1— 750 KW 480 V. 150# NC.
1— 750 KW 240 V. 150# Cd.
1— 750 KW 600 V. 175# EX.
1— 400 HP Turbine 600#

BOILERS

2—50,000# 300#
1—30,000# 400#
1—623 HP—450#
2—500 HP—200#
1—487 HP—250#
3—250 HP—125#
3—220 HP—100#
1—72" HRT 150#

DEAERATING HEATERS

3—90,000# Pr. Hr.

ENGINE GENERATORS

1—500 KW 2300 V. Unit.
1—375 KW 2300 V. Unit.
1—100 KW 220 V. Unit.

DIESEL GENERATORS

2—800 KW—2300 V.
2—200 KW—480 V.

COMPRESSORS

33,330 CFM—Cent. 75#
4800 CFM—Gas 365#
1700 CFM—100#
500 CFM—Diesel (2)

Write or wire for additional data and prices.

A. LEE ELLIS CO., U. S. Mechy. Bldg., 140 Federal St., Boston 10, Mass.

THE BUYERS MUST BE SATISFIED—ALWAYS

MOTORS—M.G. SETS—TRANSFORMERS

SQUIRREL CAGE MOTORS
3-PHASE 60-CYCLE

Qu.	H.P.	Make	Type	Volts	RPM
1	400	G.E.	1-K	2300	514
1	400	G.E.	KT-413	2200	435
1	250	Whse.	CS	2200	1160
1	200	Al. Ch.	AK	220/440	580
1	150	C.W.	120Q	220/440	570
1	125	Whse.	CS-761C	220/440	1780
1	125	Whse.	CS-772S	2200	1170
3	125	C.W.		220/440	430
1	125	Al. Ch.	AR	220/440	435
1	100	G.E.	1K	220/440	1755
3	100	Whse.	CS-660C	220/440	1750
1	100	Al. Ch.	AR-226	2200	1160
1	100	G.E.	KT-556	2200	865
5	100	F.M.	HB	220/440	880
1	100	Al. Ch.		550	720
1	100	F.M.	H-241B	220/440	450
1	75	Whse.	CS	440	1750
1	75	Al. Ch.	AR	2200	1765
1	75	Burke	BM-10	550	720
3	50	Whse.	CS	220/440	690

SYNCHRONOUS MOTORS
3 PHASE—60 CYCLE

Qu.	HP	Make	P.F.	Volts	RPM
1	1440	Whse.	.8	2300	514
1	700	G.E.	.8	2300/440	720
1	400	Whse.	.8	440	600
1	288	Al. Ch.	1.0	2200	900
1	150	Whse.	1.0	2200	400
1	125	G.E.	.8	2200	900
3	100	Whse.	.8	440	1800
1	100	Whse.	1.0	2200	1200
1	100	Ideal	.8	440/220	900
3	100	G.E.	.8	440/220	600
1	60	G.E.	.8	440/220	1200
2	50	G.E.	.8	2200	600

SLIP RING MOTORS CONSTANT DUTY
3-PHASE 60-CYCLE

Qu.	HP	Make	Type	Volts	RPM
1**	2000	G.E.		2300	240
1**	1500	Al. Ch.	ANY	2200	230
2**	1000	Al. Ch.	ANY	2300	235
1**	800	G.E.	MT-12	2300/6600	600
1***	700	G.E.	MT432	2300	400
1**	600	G.E.	MT-412	2300	720
1	500	G.E.	1M	2300/4160	580
1	500	Whse.	CW	2300	575
1	500	Whse.	CW	440	864
1***	500	G.E.	L.M.	440	450
1**	500	G.E.	MT612	2200	450
1	400	G.E.	1M	2300	575
1	400	G.E.	1M	2300	580
1**	400	Al. Ch.	ANY	2300	580
2	400	G.E.	MT412	2300	450
1	300	G.E.	1M	2300	1200
1	300	Al. Ch.	ANY	2300	585
1	250	Whse.	CW	2300	580
2	200	Whse.	CW	440	600
1	200	Al. Ch.	ANY	2300	585
1	200	Whse.	CW	550	514
1	150	G.E.	1M	440	495
1	125	Whse.	CW	2300	870
1	125	Al. Ch.	ARY	220/440	900
1	75	G.E.	1M	220/440	695
1	50	G.E.	MT-536	2300	1150
1	40	Al. Ch.	ANY	2200/440	435

**—Mill type pedestal bearing design.
***—Pedestal 3 bearing

TRANSFORMERS—OIL COOLED

Qu.	K.V.A.	Make	Type	Phase	Voltage
3	4500	G.E.	HT	3	27600/13500/2300
3	1000	Pitts.	OISC	1	23000/11000/1100/2300
4	500	G.E.	H	1	13200/11880/230/440
3	333	G.E.	H	1	6900/11950Y/230/460
3	333	G.E.	H	1	2300/460/230
3	300	Pitts.	OISC	1	13800/14400/220/460
3	150	G.E.	H	1	19000/9500/550/2300
3	100	Whse.	SS	1	12075/12075/460/230
6	100	G.E.	H	1	4160/7200Y/120/240
3	75	G.E.	KF	1	2400/4160Y/120/240
3	50	Al. Ch.	OISC	1	22000/220
2	50	Wag.	HK	1	13200/11880/575/287

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	Volts DC	Volts AC
2	1500	G.E.	600	600	4160/2400
1	1000	Whse.	514	600	4160/2400
1	1000	Whse.	514	600	2300
1	750	Whse.	514	275/300	2200
1	600	Al. Ch.	900	250	2300
1	300	G.E.	720	125/250	2300/440
2	150	C.W.	900	250	2300/440
1	100	C.W.	900	250	2300/440
1	85	C.W.	1200	250	440
1	75	Whse.	1200	125	440/220
1	75	Al. Ch.	900	250	2300
1	75	Whse.	1200	250	2300/440
5	75	Star	1200	240	2300/440
1 (3U)	50	Whse.	1700	120/240	440/220
1	35	G.E.	1800	125	440/220
1	30	Rollance	1800	250	440/220
1	25	Whse.	1200	120/240	440/220
1	18	Al. Ch.	1800	250	440/220
1	9	G.E.	1800	250	440/220

1—Rollance variable voltage set (3) 20-KW, 250-VDC Gen. with (1) 5-KW exciter and (1) 75-HP motor 440/230.

DIRECT CURRENT MOTORS
230 VOLT

Qu.	HP	Make	Type	RPM
1***	2500	G.E.	MCF-14	200/400
4***	1500	Whse.	Rel.	600
1***	1250	Whse.	MIII	200/800
1	500	G.E.	MPC	168/336
1	400	Al. Ch.	MIII	400/1200
1	325	Whse.	QM	450/900
1	200	El. Dy.	22	400/1200
1	200	Whse.	6K	300/1200
1	150	G.E.	MPC	382/525
2	125/150	Rel.	1059T	300/900
2*	150	C.W.	83H	800
2	100	Rel.	1059T	400/1200
1*	50/75	Rel.	1003P	300/1200
1*	40/60	G.E.	CD-173A	400/1200
1	50	Whse.	6K	300/1200
1*	30/75	Whse.	6K-151L	400/1200
1	35	Whse.	6K-140	300/1500
1	25	Whse.	6K-111L	250/1000

***—400-VDC mill type. *—T.E.F.C.

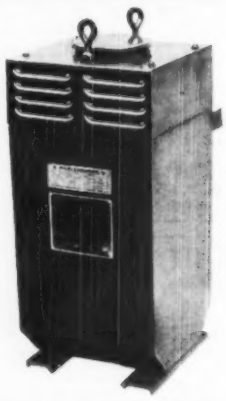
T. B. MAC CABE COMPANY

4314 CLARISSA STREET — PHILADELPHIA, PENNA.

Special Offering!

2000 NEW

air cooled
TRANSFORMERS



• WILL OPERATE ON 220 AND 440 CIRCUITS

All transformers insulated with fiber glass; no fireproof vaults required. For lighting and power.

★ LOW PRICES ★

KVA	VOLTAGE RATING
¾ to 25	450 to 117
7½ to 25	225/450 to 117/234
PHASE CHANGERS	
15 to 50	220 or 440 to 220

MANUFACTURED BY ALLIS CHALMERS

• Crated for immediate delivery

AMERICAN ELECTRIC SERVICE & MAINTENANCE CO.

SPRINGFIELD, MASS.

MOTORS • GENERATORS • TRANSFORMERS • SALES • REPAIRS • RENTALS

1—500 KW, Westinghouse, 1200 RPM, 3 Phase, 60 Cycle, 480 Volt AC Generator Direct Connected Through Worthington Gear to a Worthington-Moore Turbine, 275 Pounds; Bleeder Pressure, 10 Pounds; Exhaust, 1 Pound, Abs.

The generator panel is complete with 1000 amp. air circuit breaker, the usual instruments, voltage regulator, etc. There is also, with the unit, a Wheeler surface condenser with motor-driven circulating pump and condenser removal pump.

This equipment is located in Oakland, California and has never been used. It can be purchased at a bargain. Please address your inquiries to:

ALBERS MILLING COMPANY
5045 WILSHIRE BLVD.
LOS ANGELES 36, CALIFORNIA
Attn: W. G. Fisher

FOR SALE

Bargain, complete Diesel Power Plant for cheap and emergency power, consisting of 300 and 75 KW; 3 ph.; 60 cy.; 2400 v. units. Fairbanks Morse Modern Unit; Engineering service available.

Diesel, 521 K of P Bld., Indianapolis Ind.
Tel. Lincoln 4907

EMPLOYMENT . . . EQUIPMENT . . .
BUSINESS
OPPORTUNITIES
Whatever your need—
think "SEARCHLIGHT" FIRST

MOTORS • GENERATORS • TRANSFORMERS

200 KW M.G. SET

200 KW Westinghouse NEMA Frame Generator 250 V. DC 1200 RPM direct Connected to
300 HP. Westinghouse Synchronous Motor 3/60 220/440 Volts 1200 RPM.
AC & DC Panels—Like new. Ship now.

MOTORS

60—50—25 CYCLE
In stock—all sizes
Slipring — Squirrel Cage — Synchronous
All types of control equipment.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

DIRECT CURRENT EQUIPMENT

125-250 Volt Motors, Generators and M-G Sets with controls.

SLIPRING MOTORS

500 HP Allis Chalmers type ANY-WR 3 phase, 60 cycle, 2300 volt 514 RPM.
100 HP Westinghouse type CW 3 phase, 60 cycle, 220/440 volt 450 RPM.

FREQUENCY CHANGERS

All Sizes in Stock. 60 cycle to 90 cycle, 100 cycle, 120 cycle, 180 cycle and any other high cycle.

ALL ITEMS IN STOCK FOR IMMEDIATE SHIPMENT

NIAGARA TRANSFORMERS

1 Phase — 60 Cycle — New

Stock Shipment on sizes listed. Short delivery on sizes up to 5000 KVA—1 or 3 phase, in voltage ratings to 69 KV. Standard taps. Built to A.I.E.E. —N.E.M.A.—A.S.A. Standards.

LISTING OF TRANSFORMERS

Quantity	KVA	Primary	Secondary
3	15	7200/12470Y	240/480
3	15	2400/4160Y	240/480
3	25	2400/4160Y	120/240
6	25	2400/4160Y	240/480
3	25	7200/12470Y	240/480
3	37½	2400/4160Y	120/240
6	37½	2400/4160Y	240/480
9	50	2400/4160Y	240/480
5	50	2400/4160Y	120/240
4	75	2400/4160Y	120/240
6	75	2400/4160Y	240/480
3	100	2400/4160Y	120/240
12	100	2400/4160Y	240/480
3	167	2400/4160Y	240/480
3	167	2400/4160Y	120/240
6	250	2400/4160Y	240/480
3	333	2400 x 4800	240 x 480
3	500	7200/12470Y	240 x 480

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

BREW-WOLTMAN OFFERS

TURBINE UNITS

1—5800 KVA G. E. Non-C. 60 cy. 13200 V. 600-lb.
1—3125 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lbs., 40 lbs. BP.
1—2500 KVA G. E. Extraction Cond. 60 cy. 480 V. 185-200 lbs. steel valve sheet.
1—1563 KVA G. E. Extraction Cond. 60 cy. 480 V. 200-lbs.
1—1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lbs.
2—1250 KVA Elliott Cond. 60 cy. 480 V. 150-200 lbs. 600° Surface Condenser.
1—1250 KVA DeLaval Non-C. 60 cy. 2300 V. 250-lb.
1— 25 KW Allis Non-C. DC 125 V. Exciter. Dual drive turbine & motor.

ROTARIES—60 Cy.

1—2925 3705 KW G.E. 225 285 V. DC 200 V. AC 300 RPM
1—2000 KW Al. Ch. 600 V. DC 4150 V. AC 514 RPM
2—1000 KW West. 600 V. DC 4150 V. AC 720 RPM
1—1000 KW G. E. 600 V. DC Automatic 900 RPM
3— 750 KW West. 600 V. DC Automatic 1200 RPM
2— 500 KW West. 250 V. DC 13200 V. AC 1200 RPM

DIESEL ENGINE UNITS

2—1400 HP Fair. Morse 2400 V. 60 cy.
3—700 HP Gen. Motors 2300 V. 60 cy.
3—650 HP Amer. Loco. 440 V. 60 cy.
1—600 HP Fair. Morse 2400 V. 60 cy.
1—400 HP DeLaVergne 2400 V. 60 cy.

STEAM ENGINE UNITS

1—312 KVA Skinner Uniflow, 480 V.
1—312 KVA Ames Uniflow, 240 V.
1—250 KVA Ames Vertical Uniflow, 480 V.
2—187 KVA Ames Vertical Uniflow, 240/480 V.

SPECIALS

3—700 HP General Motors Diesel 8 cyl. 4 cy. 360 RPM dir. con. to 485 KW .8 PF 3/60/2300 V. generators.
2—1250 KVA Elliott 3/60/480 V. 3600 RPM generators dir. con. to 150-200 lbs. IP 600° TT turbines with dir. con. exciters surface condensers & pumps.

MOTOR GENERATOR SETS

2—1500 KW G. E. 600 V. DC 4150 V AC 600 RPM
2— 500 KW West. 250 V. DC 2200 V. AC 1290 RPM
1— 500 KW West. 125 V. DC 2300 V. AC 720 RPM
1— 300 KW West. 250 V. DC 440 V. AC 1200 RPM
1—200 KW G. E. 250/275 V. DC 2300 V. AC 1200 RPM
1— 75 KW Star 240 V. DC 440 V. AC 1200 RPM
1— 75 KW West. 125 V. DC 440 V. AC 1200 RPM

SYNCHRONOUS CONDENSERS

1—2500 KVA G. E. 2400 4160 V. 720 RPM
1—2000 KVA West. 2300 V. 720 RPM
2—1500 KVA G. E. 2400/4160 V. 900 RPM
1—1000 KVA West. 2300 V. 900 RPM

SYNCHRONOUS MOTORS—60 Cy.

1—4350 HP Cr. Wh. 13800 V. 514 RPM
1— 800 HP Ideal 4160/2400 V. 1200 RPM
1— 600 HP G. E. 440 V. 360 RPM
2— 350 HP G. E. 2300 V. 257 RPM
1— 300 HP G. E. 2300 V. 600 RPM
1— 300 HP West. 2300 V. 900 RPM

MERCURY ARC RECTIFIERS

2—4500 KW Multi Anode 600 V. DC
2—3250 KW Ignitron 600 V. DC
1—1000 KW Ignitron 600 V. DC

FREQUENCY CHANGERS

1—2500 KVA G. E. 25/60 cy. 300 RPM
1—1250 KVA West. 25/60 cy. 300 RPM
2—1000 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA Al. Ch. 25/60 cy. 300 RPM

TRANSFORMERS—60 Cy.

1—7500 KVA G. E.	138000—41000, 3 ph.	
2—3333 KVA G. E.	69000—6900	
1—4500 KVA G. E.	66000—33000, 3 ph.	
3—1000 KVA West.	66000—7200	
3— 75 KVA G. E.	44000—2300 4600	
1—5000 KVA West.	34500—13750, 3 ph.	
1—5000 KVA G. E.	31000—2300/4000, 3 ph.	
3— 667 KVA G. E.	33000—2300/4600	
6— 75 KVA Maloney	33000—2300/6900	
3—3750 KVA West.	28400/13200—2400	
4— 450 KVA Al. Ch.	25410/44000—13200/23000	
1—7500 KVA G. E.	13800 Rectifier type	
3— 333 KVA G. E.	13200—2400/4160 Y	
3— 750 KVA West.	13200—440	
3— 167 KVA G. E.	7200/12400—240/480	
1—1500 KVA West.	4800—2300, 3 ph. Auto	
3— 250 KVA Al. Ch.	2300—460	

OIL CIRCUIT BREAKERS

1— 600 A. 73 KV G. E. FHKO-139		Outdoor
1— 400 A. 37 KV G. E. FHKO-136-CB		Outdoor
1— 400 A. 37 KV Condit FO-40-B		Outdoor
1—1200 A. 34.5 KV G. E. FKO-330-1000		Outdoor
4—2000 A. 23 KV G.E. FKO-339-1000		Outdoor
4— 600 A. 15 KV G. E. FHKO-138BS		Outdoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW-WOLTMAN & CO., INC.

50 Church Street New York City 7 WOrth 4-1470

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
600	2200	G.E.	1800
500	2300	G.E.	450
450	440/220	Whse.	514
350	2300/440	Whse.	600
300	440/220	Whse.	900
200	2300/440	G.E.	1200
200	440	G.E.	450
150	440/220	Whse.	600
150	440/220	Whse. (2)	1800
150	2300/440	G.E.	1200
150	440/220	G.E.	720
100	440/220	G.E.	600
100 (2)	440/220	Whse.	900
100	2200/550	G.E.	1800
80	440/220	G.E. (MTC)	900
75	2300/550	G.E.	1800

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2300/440	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
250	4000/2300	El. Mchy.	Synch.	600
240	2300/440	G.E.	ATI	720
200	440/220	G.E.	TS	720
200	4150/2300	Whse.	G	1800
150	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2300/440	Whse.	GE	600

GENERATOR SETS

1—62½ kva. 1200 rpm, 220 volt. Whse., geared to 7300 rpm. Whse., non-cond. steam turbine, 150 lbs. pr.
2—unused 35 kva. 120/240 v., 3 ph., 1200 rpm. generator dir. conn. to Waukesha 6 cyl. gas engine

TURBO-GENERATOR

Generator, 62½ kva. 1200 rpm, 440/220 V., Whse., geared to 30 kw, 7300 rpm, non-condensing.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
3—1200 ampere, Whse., 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
650	440	G.E.	PT	3600
500	2200	Cr. Wh.	SC	1800
500	440/220	G.E.	IR	900
350	2200	G.E.	KT	1200
300	2200	G.E.	FT	3600
300	2200	G.E.	KT	1800
250	2200/440	L. Allis	OGB	1200
200	440	G.E.	IR	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
200	440/220	G.E.	IK	450
150	440/220	G.E.	IK	450
100	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTF	1200
150	440/220	G.E.	IK	514
150	440/220	Whse.	CS (NEW)	900
100	2200/440	G.E.	K	1200

A. C. GENERATORS

1—320 kva. 600 rpm, 2300/440/220 V., G.E.
1—250 kva. 720 rpm, 2300/440 v., G.E.
1—225 kva. 600 rpm, 220/440 v., G.E.
1—225 kva. 720 rpm, 2300/440 v., G.E.
1—150 kva. 900 rpm. 480/240 v., G.E.
3— 75 kva. 1800 rpm. 480/240 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
350	230 (2)	G.E.	CD	1150
350	230 (3 new)	Cr. Wh.	CMC	1800
300	230	Cr. Wh.	CMC	900
150	230 (new)	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	BK	850

MOTOR GENERATOR SETS

1—300 kw, 1200 rpm, 250 v., G.E., connected to 500 hp, 1200 rpm, 2300/440 v., synchronous
1—185 kw, 1200 rpm, 240 v., G.E., conn. to 250 hp, 1200 rpm, 440/230 v., squirrel cage
1—100 kw, 250 v., Hertner, 1200 rpm, connected to 150 hp, 2200/440 v., synchronous
1—90 kw, 1200 rpm, 250 V., G.E., connected to 135 hp 2300/440 V. squirrel cage motor
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2300/440 v., syn. motor
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/220 V., sq. cage

TRANSFORMERS 60 Cy.

2—667 kva, Whse., 33,000—2300 V.
2—333 kva, G.E., 13,200—2300 V.
2—333 kva, Whse., 2400—480/240 V., Dry
3—250 kva, G.E., 6900/13,800—230/460 V.
2—250 kva, Whse., 11,000/22,000—2300 V.
2—250 kva., Whse., 2300—208 V.
3—200 kva, Whse., 13,200—2300 V. (Inerteen)
6—150 kva, Al. Chal. 2400—240/120 v.
1—150 kva, Whse, SK, 13200-125/215 v., 3 ph
3—100 kva, G.E., 4600/2300—230/460 V.
3—100 kva, G.E., 13800—230/115 v., NEW
6—100 kva, G.E., 4600/2300-230/115 v., NEW
2—100 kva, G.E., 459-115/230 v., dry, 1 ph, new
2—75 Kva, G.E., 480—240/120 v. Pyranol
3—50 kva, G.E., 480—240/120 V., Pyr

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

DIESEL GENERATOR PLANTS

COMPLETE WITH SWITCHBOARDS

1000 KW to 100 KW

STATIONARY and PORTABLE

AT GREATLY REDUCED PRICES

NEW UNIT GUARANTEE

HERCULES ELECTRIC MACHINERY and EQUIPMENT CO.

Tel. NE vada 6-2808
Cable Address HEMCOY

1412 So. Alameda Street
Compton, Calif.

TWO STOKERS, COMPLETE

Detroit Overfeed Rotostoker—double feed. Capacity: 500 boiler H.P. Grate area: 45 sq. ft. Grate dimensions: 6 ft. x 7 ft. 6 in. Stokers complete with forced draft fans. Stoker parts: 4 feed units, 2 drive units, 2 blower fans, 2 wind tunnels, 2 set grates, 2 boiler fronts for mounting feed units.

PURITY BAKERIES

97 E. 12th St. St. Paul 1, Minn.

If there is anything you want

or something you don't want that readers can supply—or use—*advertise it in the*

Searchlight Section

Tremendous Sacrifice—Direct from Owner—On Original Foundations—Complete

STEAM-ELECTRIC POWER PLANT INTACT

PERFECT OPERATING ORDER — PRODUCING 1220 HP — 976 KVA

2—SKINNER UNAFLOW ENGINES, 384 KW each, 440 volts, 3 phase, 60 cycle, 26" x 30" cylinder, 150 RPM Synchronous, 185 psi, 381°, with GE ALTERNATOR

1—WESTERN ELECTRIC ALTERNATOR, 260 KVA, 240 volts, 3 phase, 60 cycle, with SKINNER UNAFLOW belt driven EXCITER

1—UNIVALVE ENGINE with GE 75 KW Direct Current Generator and Steam Driven Exciter, 14 x 15 cylinder 80 psi

3—600 HP EDGEMOOR BOILERS, Straight Tube, Oil Fired, 150# 300# Fuel Oil Pressure, Chute-Koerting Assembly, COMPLETE WITH BOILER AUXILIARIES

1—30 TON TRAVELING CRANE
1—2 HP MOTOR GENERATING SET
3—100 KVA TRANSFORMERS, 440 volts
3—333 KVA TRANSFORMERS, 13,200 volts
3—15 HP WESTINGHOUSE MOTORS connected to Forced Draft Blowers, 220-440 volts
LUBRICATING SYSTEM, FLOW METERS, TOOLS

HANDLING EQUIPMENT ON PREMISES FOR AID IN DISMANTLING

For Additional Information Write or Wire Joseph Metzger

JACKSON-CROSS CO. LINCOLN-LIBERTY BLDG., PHILADELPHIA 7, PA.

GENERATE YOUR OWN POWER WITH "UTILITIES APPROVED" EQUIPMENT

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

6250 KVA G.E. condens., 5 stage, 2300/4000 volts, 200# pressure, 600° TT, 3600 RPM.

3125 KVA G.E. condens. 130 P.S.I. 550 volts.

3125 KVA G.E. condensing 175/200 P.S.I., 2300 volt, 500° TT, 3600 RPM complete.

2500 KVA G.E. Type ATB Form HT, 2300/480 volts.

3600 RPM alternating current generator LESS TURBINE.

1563 KVA G.E. non-condensing 250 P.S.I. 25# gauge back, 2400 volts, 3600 RPM.

1563 KVA G.E. condensing 250 P.S.I. 2300 volts, 3600 RPM complete.

625 KVA Allis-DeLaval non-cond. 80 to 125 P.S.I. 10 to 15# gauge 2300/480 volts.

625 KVA Westinghouse condensing 150/200# pressure, 2300 volt, 3600 RPM complete.

625 KVA G.E. non-condensing 150# pressure 15# back, 2300 volts, 3600 RPM complete.

375 KVA (4) G.E. condensing 400# pressure, 480/600/2300/4150 volts complete.

112 KVA G.E. non-condensing 125# pressure 10# gauge back 480 volts.

100 KVA Westg. non-condensing 125 to 150# pressure, 10# gauge back, 2400 volts.

Direct Current

400 KW (2) 240 volts direct current Crocker-Wheeler Worthington 440 lbs. condens.

150 KW (2) 3 wire, 250 volts, 225/250 P.S.I. Westinghouse-Worthington condensing.

100 KW G.E. 125 volt 200-275 P.S.I.

75 KW Allis-Chalmers-Terry, 125 volts, 2400 RPM, 150# pressure non-condensing.

75 KW (2) Westinghouse - Moore 120 volt, 200# pressure, condensing.

60 KW (3) new Westinghouse 120 volt, 200# pressure, condensing.

SYNCHRONOUS MOTORS

3 Phase, 60 cycle

5000 KVA Westghs. 4000 volt, 720 RPM (condenser)

900 HP Allis, 2200 volts, 150 RPM

750 HP G.E. 2300 volts, 720 RPM.

300 HP 80% P.F. G.E. 2300 volts, 720 RPM

MOTOR GENERATOR SETS

500 KW General Electric 600 volt DC, direct connected to 710 HP, 3 phase 60 cycle, 2300 volt, 720 RPM synchronous motor.

400 KW General Electric 275 volt DC, direct connected to 710 HP, 3 phase 60 cycle 2300 volts, 720 RPM synchronous motor.

300 KW Allis, 250 volts DC generator direct connected 430 HP Allis 3 phase 60 cycle, 440 volt, 1200 RPM synchronous motor.

150 KW G.E. 125 volt direct current generator direct connected 225 HP, 3 phase 60 cycle 220 volt, 1200 RPM synchronous motor.

62½ KVA G.E., 60 cycle, 2300 volt, alternator to 75 HP, 125 volt DC motor.

ENGINE-GENERATOR UNITS

Direct Current

400 KW G.E. 240 volts, 360 RPM generator connected Skinner Unaflow vertical engine 150#, 10# gauge back.

275 KW Westinghouse 250 volt, generator connected Ames vertical Unaflow engine.

250 KW (2) G.E. 3 wire 250 volts generators connected Skinner Unaflow Engines.

100 KW Burke 3-wire, 250 volt generator connected Skinner Unaflow engine.

Alternating Current—3 phase, 60 cycle

750 KVA G.E. 2300 volts generator connected Skinner Vertical Unaflow non-condensing engine 150# P.S.I.

625 KVA Westinghouse 240 volts, generator connected Skinner Unaflow Engine.

500 KVA G.E. 2400/480/240/volts generator connected Ames Vertical Unaflow Engine.

375 KVA G.E. 2300/440 volts, generator connected 23"x24" Skinner Horizontal Unaflow Engine 120—150 P.S.I.

175 KVA Westg. 240 volt generator connected Skinner Horizontal Unaflow Engine.

JULY BARGAINS

1—8400 sq. ft. and 1—4400 sq. ft Worthington surface condensers.

4—900 KW, 250/375 volt, direct current generators connected 1200 HP, 8 cylinders 720 RPM Fairbanks Diesel Engines.

1—5425 GPM, 70 foot head Centrifugal pump connected 125 HP 60 cycle, 2200 volt, 1750 RPM G.E. motor.

2—1000 GPM, 1270 foot head, 4-stage, Morris pumps each direct connected to a 417 HP, 390# P.S.I. non-condensing G.E. turbine.

UMC UTILITIES MACHINERY CORP.

1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422

Diesel Engines for Sale

2 Venn-Severin 75 HP Diesel Engines

400 RPM, Mfg. in 1938, belted connected to 60 KVA General Electric 3 phase, 50/60 cycle, 220 volt alternators.

Price .....$1,500.00 Ea.

Can be inspected on original foundation under power.

Excellent condition.

A. J. WINSTON

517 South Delaware Street

Indianapolis 4, Indiana

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Expert Orders Carefully Executed"

BOILER UNITS	TURBO UNITS
1—140,000# New Steam Generator 600#, also Super	1—10,000 KW Turbo-Generator—Cond.
2—90,000# Boilers, 625#, 825° F.tt., Economizer and Air-heater	1— 7,500 KW Turbo-Generator—Cond. 600#
2—60,000# B&W 450# superheat	1— 7,500 KW Turbo-Generator, Cond.
3—30,000# B&W 450# superheat	1— 5,000 KW NEW 400# Cond. Unit complete
1—1000 HP Erie City Boiler, 200#	1— 5,000 KW Turbo-Generator—Cond.
1—680 HP B&W Cross Drum Sectional Header 200#, Super	2— 3,000 KW & 2—2500 KW Cond.
6—600 HP Each Best tube type 200#, superheat	3— 2,000 KW same as above } Also 400# &
2—600 HP B&W Sectional Header, Super., 200#	2— 1,500 KW same as above } 600# turbos
3—500 HP Stirling type Boilers, 450#, superheat	2— 1,250 KW same as above
2—500 HP B&W Sectional Header 200# Boilers	2— 1,000 KW same as above
Also smaller Boilers & Fire Tube Boilers	1— 500 KW same—Also 750 KW & 300 KW Units

Non-Cond :—300—500—750—1000—1500—2000

Complete Steam Plants with 2—1250 KW; 2—2500 KW; 2—3000 KW & 7500 KW

Frequency Changers—Transformers! Send us your requirements—We may have it

Send us your INQUIRIES *for* ALL POWER MACHINERY

CHARLES B. REARICK **30 CHURCH ST.** **NEW YORK 7, N. Y.**

Most all units still on foundation. Many may be seen operating

TURBO. GENERATOR UNITS

1000 KW. (2) Elliott Condensing-Bleeder 3/60/480 V.

500 KW GE 3/60/2400/4160 V—Murray, Cond.

ALSO TURBO UNITS; NON-CONDENSING & CONDENSING; from 50 KW. to 2500 KW.

BOILERS

LBS OF STEAM PER HOUR

45000 B&W SEC. HDR., 200#

40000 B&W FF 15; Integral furnace 200#

25000 B&W F16; Integral Furnace 200#

15000 (2) B&W 3 drum; low hd., 160#

15000 (2) B&W 3 drum; low hd., 200#

10000 Keeler; self contained, 250#

STEAM ENGINE SETS A.C.

500 KVA GE-Skinner Uniflow

312 KVA (2) GE-Skinner Uniflow

187 KVA Wghse.-Ames Uniflow, *Vertical*

62 KVA GE-Ames Uniflow

DIESEL UNITS A.C.

1225 KVA Fairbanks Morse, 7 cyl., 300 RPM

1250 KVA (2) GE-Superior, 8 cyl., 360 RPM

250 KVA (2) GE-Buckeye 8 cyl.

106 KVA GE-Murphy 6 cyl., *Portable*

90 KVA Fairbanks Model 32

75 KVA (2) General Motors; *Portable*

ALL SIZES UP TO 1250 KVA

COMPRESSORS

850 CFM (2) 110 lbs., Chicago Pneumatic, *diesel driven*

ALSO ALL SIZES 150 CFM to 1000 CFM.

PUMPS (Motor & Turbine Driven)

From 200 to 2500 GPM; from 200 to 2500' hds.

BLOWERS (Turbine & Motor Driven)

ALL SIZES UP TO 10,000 CFM

HEATERS (Deaerating)

FROM 50M to 250M # per Hr.

ELECTRIC FURNACES

ALL SIZES; COMPLETE WITH SWITCHGEAR & TRANSFORMERS

STOKERS, PULVERIZERS — ALL SIZES AND TYPES.

CORLISS ENGINE — 18x36 Allis Chalmers (New)

TRANSFORMERS—MOTOR GENERATOR SETS

Above listed units are only a few of our "SPECIALS". Advise your plant requirements.

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt St.
New York, N. Y.

ADVERTISERS' INDEX

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

Aerotic Corp. ..... *
Air Preheater Corp. 209
Air Express Div.
Railway Express Agency 190
Allen-Sherman-Hoff Co. ..... *
Alliance Electric Works, Ltd. 260
Allis-Chalmers Mfg. Co. 43, 59, 69, 183
American Blower Co. 226
American Brass Co. 137
American Chain & Cable Co. 167
American Chimney Corp. 260
American District Steam Co. ..... *
American Engineering Co. 61
American Pulverizer Co. 68
Anchor Packing Co. 239
Arkansas Fuel Oil Co. 55
Armstrong Cork Co. 175
Armstrong Machine Works 141
Atlas Valve Co. ..... *
Aurora Pump Co. ..... *

Babbitt Steam Specialty Co. 214
Babcock & Wilcox Co. 4-5
Babcock & Wilcox Tube Co. 240
Badger Mfg. Co. 256
Bailey Meter Co. 10-11
Baltimore & Ohio Railroad 228
Beaumont Birch Co. ..... *
Bell & Gossett Co. ..... *
Belmont Packing & Rubber Co. ..... *
Bernitz Furnace Appliance Co. ..... *
Betz Co., W. H. & L. D. 133
Biddle & Co., James G. ..... *
Bigelow Company 178
Birch Mfg Co. 260
Bird-Archer Co. ..... *
Black, Sivalls & Bryson, Inc. 180-181
Blaw-Knox Co. ..... *
Boiler Tube of America 200
Bowser, Inc. ..... *
Bridgeport Brass Co. 64
Brown Boveri Corp. ..... *
Buell Engineering Co. 241
Buffalo Forge Co. 243
Buffalo Pumps, Inc. 193
Burgess-Manning Co. 54
Bussmann Mfg. Co. 40-41
Byers Co., A. M. 74

Canton Stoker Corp. ..... *
Cardox Corp. ..... *
Carey Mfg. Co., Philip 216
Cash Co., A. W. 199
Catawissa Valve & Fittings Co. 200
Chapman Valve & Mfg. Co. 161
Chase Brass & Copper Co., Inc. 34
Chelsea Fan & Blower Co., Inc. ..... *
Chicago Metal Hose Corp. ..... *
Chicago Pneumatic Tool Co. 245
Cities Service Oil Co. 55
Clarage Fan Co. 232
Clark Mfg. Co. 160
Cleaver-Brooks Co. ..... *
Cochrane Corp. 164

Coffin, Jr. Co., J. S. 182
Combustion Engrg.-Superheater, Inc 26-27
Condenser Service & Engrg Co. 219
Coppus Engineering Co. 165
Crane Company 149
Cyclotherm Corp. 256

Darling Valve & Mfg. Co. ..... *
Dart Mfg. Co., E. M. ..... *
Davis Regulator Co. 208
Dearborn Chemical Co. 263
DeLaval Separator Co. 177
DeLaval Steam Turbine Co. 215
Detroit Stoker Co. 191
Diamond Power Specialty Corp. 8-9
Dowell, Inc. 155
Dravo Corp. 37, 194
Drew Co., E. F. ..... *

Eagle-Picher Co. 46-47
Eastern Gas & Fuel Associates 187
Economy Pumps, Inc. ..... *
Edward Valves, Inc. 157
Electric Machinery Mfg. Co. 217
Electric Storage Battery Co. ..... *
Elgin Softener Corp. 201
Elliott Co. 6-7
Engineer Co. 189
Erie City Iron Works 257
Ernst Water Column & Gage Co. 260

Fairfield Engineering Co. 284
Fairmont Coal Bureau ..... *
Fisher Governor Co. 205
Flexitallic Gasket Co. 151
Flexo Supply Co., Inc. 258
Foster Engineering Co. 173
Foster Wheeler Corp. 32-33
Foxboro Co. 174
Frick Co. ..... *
Fuller Co. ..... *

Garlock Packing Co. ..... *
General Electric Co.
(Apparatus Dept.) 14-15, 21, 35-36, 44-45, 66, 194
Globe Steel Tubes Co. 211
Golden-Anderson Valve Spec. Co. 253
Goodyear Tire & Rubber Co. ..... *
Gorman-Pump Co. ..... *
Goulds Pumps, Inc. ..... *
Graver Water Conditioning Co. 251
Grinnell Co. ..... Third Cover
Griscom-Russell Co. 233
Gulf Oil Corp. 171
Gulf Refining Co. 171
Gunite Concrete & Construction Co. 218

Hagan Corp. 18-19
Hall Laboratories 65

Harbison-Walker Refractories Co. ..... *
Hays Corp. ..... *
Heacon, Inc. ..... *
Hendrick Mfg. Co. 188
Henszey Co. 222
Hewitt-Robins, Inc. 170
Hill Pump Valve Co. 260
Hoffman Specialty Co. ..... *
Honan-Crane Corp. ..... *

Illinois Water Treatment Co. ..... *
Industrial Sound Control Co. ..... *
Infilco, Inc. 76
Ingersoll-Rand Co. 227
International Nickel Co. ..... *
Iron Fireman Mfg. Co. 230

Jeffrey Mfg. Co. 207
Jenkins Bros. 144-145
Jerguson Gage & Valve Co. ..... *
Johns-Manville 139, 206
Jones Foundry & Machine Co., W. A. 260
Joy Mfg. Co. 179

Keasbey & Mattison Co. 58
Kellogg Co., M. W. 213
Kennedy Valve Mfg. Co. ..... *
Kennedy-Van Saun Mfg. & Engrg. Corp. 22-23
Kewanee Boiler Corp. ..... *
Kieley & Mueller, Inc. ..... *
Kinney Mfg. Co. 225
Kilpfel Valves, Inc. ..... *
Koppers Co., Inc. (Coupling Dept.) 231
Kuljian Corp. ..... *

Ladish Co. 53
Lapp Insulator Co., Inc. ..... *
Leeds & Northrup Co. ..... Second Cover
Leslie Co. ..... *
Link-Belt Co. 3
Littleford Bros., Inc. (Gen. Div.) ..... *
Lockett & Co., A. M. 212
Lummus Co. ..... *
Lumnita Div.
Universal Atlas Cement Co. ..... *
Lunkenheimer Co. 38-39

Manheim Mfg. & Belting Co. ..... *
Manning, Maxwell & Moore, Inc. 250
Manzel, Inc. ..... *
Marley Co. ..... *
Marsh Instrument Co. ..... *
Mason-Neilan Regulator Co. 196
McGraw-Hill Book Co. 214
Mercoid Co. ..... *
Midwest Piping & Supply Co. 235
Milton Roy Co. ..... *
Minneapolis-Honeywell Regulator Co.,
(Industrial Div.) 63, 229
Mitchell & Co., W. h. ..... *

Modine Mfg. Co. ..... *
Monsanto Chemical Co. 218
Murray Iron Works 224

Nagle Pump Co. ..... *
National Airoil Burner Co., Inc. 214
National Aluminate Corp. 143
National Electric Coil Co. ..... *
National Tube Co. ..... *
National Valve & Mfg. Co. 203
Niagara Blower Co. ..... *
Nicholson & Co., W. H. 188
Nordberg Mfg. Co. 12-13
Northern Equipment Co. 147
Norton Co. 235

Oakite Products, Inc. 194
Ohio Injector Co. 247
Owens-Illinois Glass Co. (Kaylo Div.) ..... *

Pacific Pumps, Inc. ..... *
Paraffine Companies, Inc. ..... *
Peabody Engineering Co. ..... *
Peerless Pump Div.
Food Machy. & Chemical Corp. 246
Pennsylvania Crusher Co. ..... *
Penn Flexible Metallic Tubing Co. ..... *
Permutit Company ..... *
Petro-Chem Development Co., Inc. 206
Philadelphia Gear Works 42
Pipe Fabrication Institute ..... *
Pittsburgh Piping & Equipment Co. 244
Powell Co., Wm. 28-29
Powers Regulator Co. 220
Prat-Daniel Corp. ..... *
Preferred Utilities Mfg. Co. ..... *
Pritchard & Co., J. F. 172

Raybestos-Manhattan, Inc.
Packing Div. 234
Reading, Pratt & Cady Div. 167
Reliance Gauge Column Co. 52
Republic Flow Meters Co. 48-49
Republic Rubber Div.
Lee Tire & Rubber Co. 249
Republic Steel Corp. 30-31
Revere Copper & Brass, Inc. 159
Richardson Scale Co. 204
Rie-Wil Co. 169
Riley Stoker Corp. 108-109
Rohm & Haas Co.
(Resinous Prod. Div.) ..... *
Ross Heater & Mfg. Co. 238
Roto Div. of Elliott Co. 202

Sante Fe Tank & Tower Co. ..... *
Sarco Co. 50
Sauerman Bros., Inc. 222
Schutte & Koerting Co. 135
Shaw Co., B. F. 127
Sier-Bath Gear & Pump Co. ..... *
Simplex Valve & Meter Co. ..... *
Sinclair Refining Co. ..... *
Skinner Engine Co. 186
Smith Corp., Winfield H. 192
Smith Refractories, Sanford S. ..... *
Socony-Vacuum Oil Co. ..... *
Sparkler Mfg. Co. 168
Spence Engineering Co., Inc. ..... *
Springfield Boiler Co. ..... *
Standard Oil Co. of Indiana 110A-110B
Standard Stoker Co., Inc. ..... *
Steel & Tubes Div. 30-31
Stephens-Adamson Mfg. Co. 20
Sticht Co., Inc., Herman H. ..... *
Stickle Steam Specialty Co. ..... *
Stock Equipment Co. 162, 212
Stone & Webster Engrg. Corp. 163
Strong, Carlisle & Hammond Co. 184
Struthers Wells Corp. ..... *
Startevant Div.
Westinghouse Electric Corp. 56-57
Sun Oil Co. 131
Superior Combustion Industries 197
Swartwout Co. 153
Sweet's Catalog Service ..... *

Taylor Forge & Pipe Works 261
Taylor Instrument Co's 242
Territorial Information Dept. 252
Terry Steam Turbine Co. 51
Texas Co. ..... Back Cover
Thermix Corp. ..... *
Tidewater Associated Oil Co. 195
Tilco-Fin Div., David E. Kennedy, Inc. 259
Timken Roller Bearing Co. ..... *
Todd Shipyards Corp.
Combustion Equipment Div. ..... *
Toledo Pipe Thread. Mach. Co. 176
Tri-Lok Co. 194
Troy Engine & Machine Co. ..... *
Trumbull Electric Mfg. Co. 60
Tube-Turns, Inc. 221

Union Iron Works ..... *
U. S. Steel Corp. ..... *

Viking Pump Co. ..... *
Vogt Machine Co., Henry 62
Vulcan Soot Blower Corp. 24-25

Wallace & Tiernan Products, Inc. ..... *
Walworth Co. 223
Warren Steam Pump Co. 237
Watson-Stillman Co. 198
Western Chemical Co. 166
Westinghouse Electric Corp. 72-73
Weston Electrical Instrument Co. 210
Wheeler Mfg. Co., C. H. 236
Where to Buy 260
Wickes Boiler Co. 185
Wilmot Engineering Co. ..... *
Wing Mfg. Co., L. J. ..... *
Worthington Pump & Machy. Corp. ..... *
Wright Chemical Corp. 258

Yarnall-Waring Co. 16-17, 139
Youngstown Sheet & Tube Co. 67

Zallea Bros. ..... *

Professional Services **262**

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT

Positions Vacant 265, 266
Selling Opportunities Offered 265
Positions Wanted 265
Selling Opportunities Wanted 265
Employment Services 265

EDUCATIONAL

Books 265

EQUIPMENT

(Used or Surplus New)
For Sale 266-281

WANTED

Equipment 277

ADVERTISERS INDEX

Albers Milling Co. 278
Aljohn Diesel Co., Inc. 272, 276
American Air Compressor Corp. 268
American Electric Service & Maint. Co. 278
Arrow Transformer Co., Inc. 278
Atlantic Transformer Co. 275
Bauer, L. W. 277
Belyea Co., Inc. 277
Boswick Electric Co., The 272
Brearley, H. P. 270
Brew, Woltman & Co., Inc. 279
Buffalo Transformer Co. 275
Chicago Electric Co. 275
Darien 278
Diesel 278
Douglass Co., Stephen A. 268
Duquesne Electric & Mfg. Co. 273
Electric Apparatus Repair Co. 277
Electric Equipment Co. 268
Electric Generator & Motor Co. 268
Electric Service Co., Inc. 274
Ellis Co., A. Lee 277
Erie Electric Co., Inc. 279
Glow Electric Co. 276
H & P Machinery Co. 274
Hall & Co., Stephen 280
Heat & Power Co., Inc. 273
Hemphill & Co., J. L. 271
Hercules Elect. Machy & Equip. Co. 280
Hobson & Sons, Russell B. 277
International Power Machinery Co. 269
Jackson-Cross Co. 280
Johnson & Associates, Howard H. 275
Kane-McGuire Co. 272
Kirk Co., Wallace E. 273
Land, Inc., L. J. 274
Leeds & Northrup Co. 265
Lefax 265
MacCabe Co., T. B. 278
Martin, William L. 274
Merrill & Co. 275
Mississippi Valley Equipment Co. 277
National Boiler & Equipment Co. 276
Northern Metal Co. 270
O'Neill, A. J. 276
Penn. Machinery Co. 277
Pierce Cable Co. 277
Power Plant Equipment Co., Inc. 281
Powerite Corp. 277
Purity Bakeries 272, 280
Rearick, Chas. B. 281
Republic Textile Equipment Co. 275
Schoonmaker Co., Inc., A. G. 270
Stanhope, L. M. 270
Sundfelt Equipment Co., Inc. 268, 274
Surplus & Salvage Co., Inc. 274
Tarpy Electric Machinery 270
Thompson Co., Inc., J. Parker 275
Tomsett Associates 265
Universal Wire & Cable Co. 270
Utilities Machinery Corp. 281
Wagner Co., Arthur 266
Wagner Breweries, Inc., August 274
Waterloo Water Works 274
Weaver, Charles 267
Wente Electric Co., The 276
Western Regulator Exchange 268
Winston, A. J. 281
Winston Machinery Co., Inc. 268, 277

Progressive

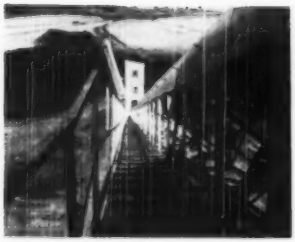
FAIRFIELD

Engineering

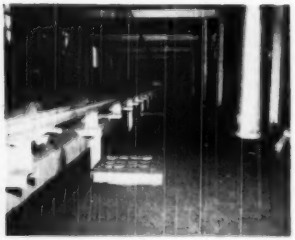
SERVING THE NATION'S POWER PLANTS

PLANNED EFFICIENCY AT WORK!!

● There was a time when watch mechanisms were considered intricate, but today's power plant coal handling systems can well share the same distinction. Take the southern rayon plant installation pictured above recently completed by Fairfield. Five conveyors supply coal to the powerhouse bunkers or to optional ground storage in a timed and synchronized capacity cycle. From the time the coal hits the double track hopper until it rests in the bunkers, Fairfield planning and engineering assure the efficient performance of this coal handling system. Take advantage of this outstanding experience and engineering know-how today by calling in your Fairfield engineer.



View down walkway alongside elevator belt. Note extensive ground storage area.



Distributing belt conveyor over bunker. Automatic tripper in background.

THE FAIRFIELD ENGINEERING COMPANY

BUILDERS OF DEPENDABLE COAL AND ASH HANDLING EQUIPMENT

335 CHICAGO AVENUE

Marion, Ohio

Puzzle for experts

There is no need for "cutting and trying" on the job to make a prefabricated piping sub-assembly fit perfectly. Prefabricated miles away to exact dimensions and specifications these pieces of piping are links in piping systems which may carry steam up to 2500 p.s.i. and 1050°F.

Grinnell integrates the many factors in this complex, highly technical assignment in one organization of specialists. Major economies result from this single responsibility which includes interpretative engineering, metallurgical research, compliance with code requirements, manufacturing drawings and specifications, production schedules, purchase of materials, specialized facilities, skilled personnel, control of quality and rigid inspection.

You'll find it to your own best interests to draw upon Grinnell's century-long, specialized experience in power, process and industrial piping.

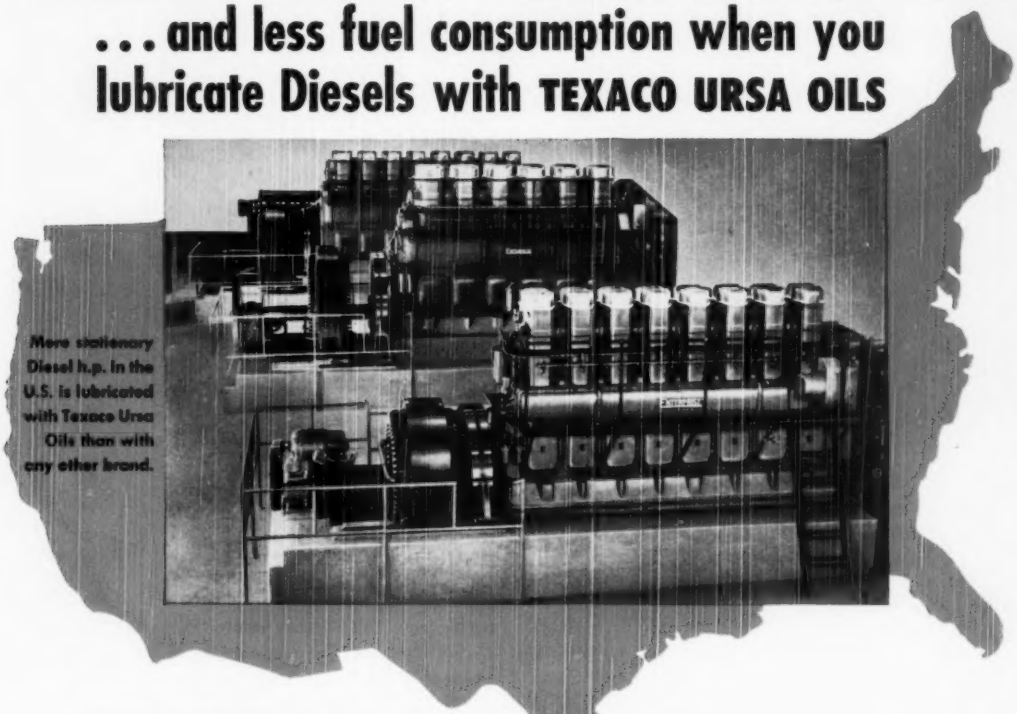
100 YEARS OF PIPING

GRINNELL

Grinnell Company, Inc., Providence, R. I. Branches: Atlanta • Billings • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

Better Compression ...Better Combustion

...and less fuel consumption when you lubricate Diesels with TEXACO URSA OILS



More stationary Diesel h.p. in the U.S. is lubricated with Texaco Ursa Oils than with any other brand.

Texaco Ursa Oils are especially made to stand up under heat and pressure and to resist oxidation. They keep engines free of harmful carbon, varnish and sludge. Thus, valves stay active, ports open, and rings free for proper seal. Better compression and combustion, and lower fuel consumption result.

Maintenance costs, too, are lower, because *Texaco Ursa Oils* maintain their friction-fighting films . . . constantly guarding against wear and assuring longer life for bearings, pistons, rings, and cylinder liners.

There is a complete line of *Texaco Ursa Oils.* Leading Diesel engine manufacturers approve them and operators everywhere use them for every type and size of Diesel engine.

Let a Texaco Lubrication Engineer work with you to bring down your Diesel operating costs. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Ursa Oils

FOR ALL DIESEL ENGINES